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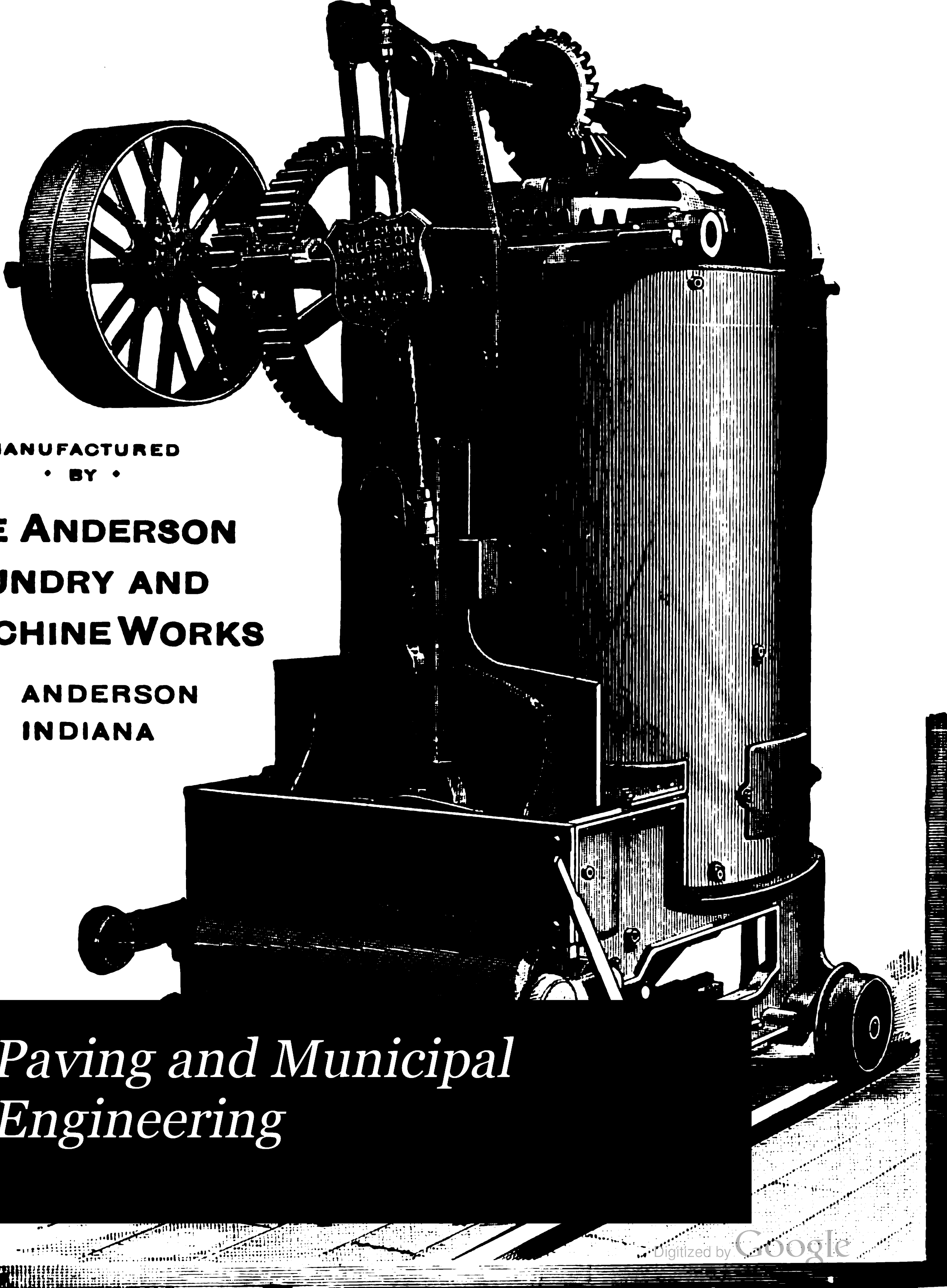

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VOLUME IV.

MUNICIPAL ENGINEERING COMPANY,
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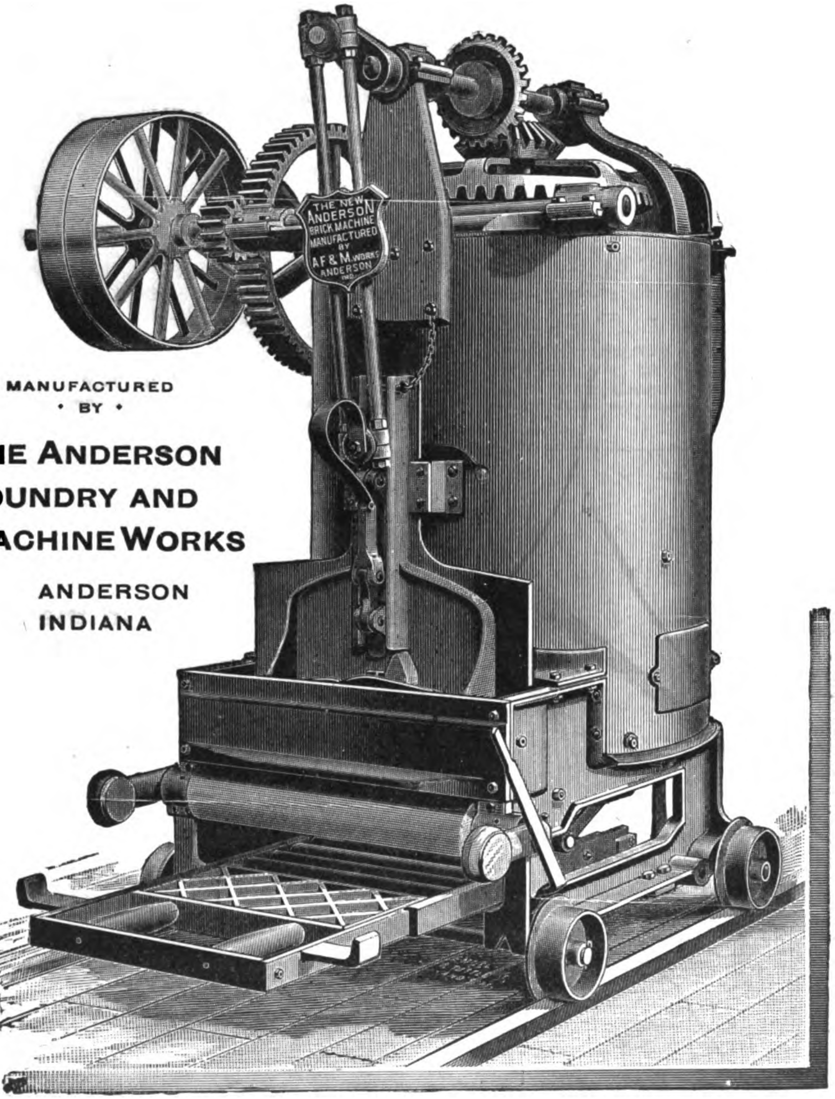
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Wellington Machine Co 28
Western Chemical Co 12
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Williamson & Earl 10
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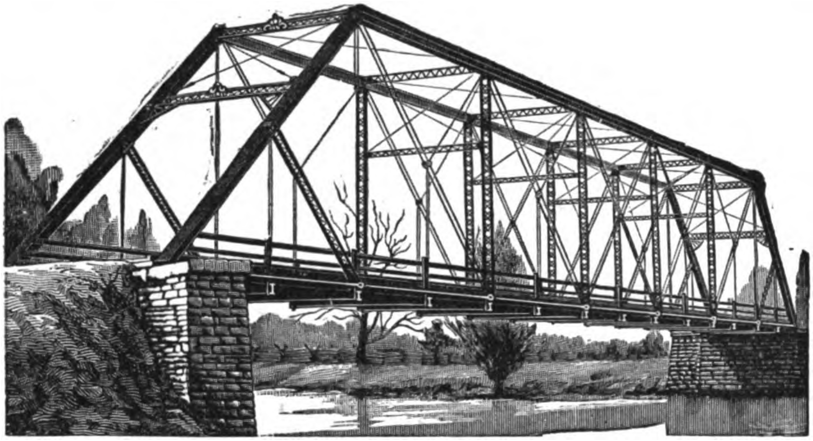

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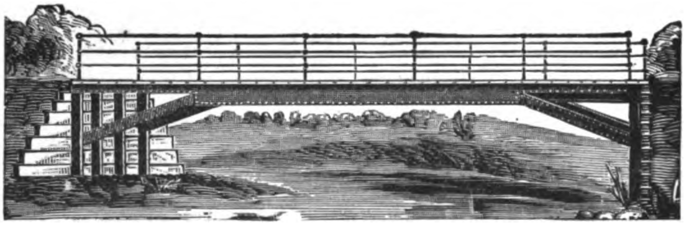

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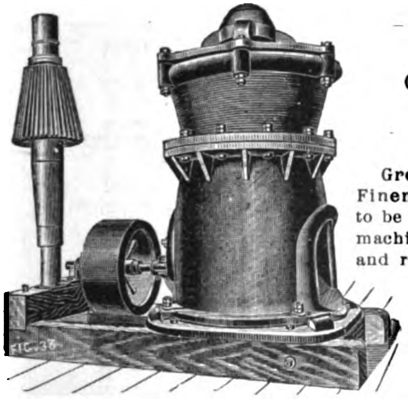

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Size 3	10 to 20 tons per hour
Size 4	15 to 30 tons per hour
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. . . PATENTED MAY 20, 1890 . . .

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THE INVENTOR of the Anchor Iron Bound Curb has been for several years engaged in the business of laying Artificial Stone Pavements, and has put down large quantities of Cement Curbing, as at present used. THIS HAS ONE SERIOUS DEFECT, viz.: The liability to break or chip off at the outside edge or corner, from the impact of wheels of vehicles of all kinds, trucks, coal carts, milk or express wagons; even wheelbarrows or bakers' carts will chip off pieces when rudely pushed against this edge, and destroy its symmetry. The effort to overcome this objection has resulted in the present patented improvement, which is designated THE ANCHOR ARTIFICIAL CURB.

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PROPOSALS.

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Sealed proposals will be received at the office of the Village Clerk of Berea, Ohio, until 6 o'clock P. M., Monday. January 16, 1893, for the grading, curbing and paving with sandstone; also proposals for paving with paving brick, Front street, from the north line of Bagley road to the south line of the C. C. C. & St. L. railway property, in accordance with plans and specifications now on file in the office of the Village Clerk, where blank proposals may be had. Each proposal must contain the full name of the party or parties making the same, and all parties interested in the same, and must be accompanied with a bond of $500, with good security, that if the same is accepted, a contract will be entered into. Proposals will also be received for the grading separate from the paving and curbing. No proposal will be considered unless made on blanks furnished by the Clerk.

C. F. LANE, Clerk.

PROPOSALS FOR DISPOSAL OF GARBAGE.

Sealed proposals will be received at the office of the City Comptroller of the city of Dayton, Ohio, until 12 o'clock noon, Monday, January 30, 1893, for the sanitary disposal of the garbage of the city of Dayton, Ohio, for the period of fifteen (15) years, according to the specifications on file in the office of the Board of City Affairs.

Bidders must endorse their names and the work bid for upon the outside of the envelope containing their bids.

Bidders to use the printed forms, as none other will be received.

Each bid to be accompanied by two disinterested sureties.

The Board reserves the right to reject any or all bids.

By direction of the Board of City Affairs.

H. C. MARSHALL, President.
C. A. HERBIG, City Comptroller.

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Brick Street Pavements; a thorough article, giving specially valuable information, by WILLIAM STEYH, City Engineer of Burlington, Iowa, one of the highest authorities on the subject.

Annealing Paving Brick; a practical treatise of great value to manufacturers of paving brick, by WILLIAM WAPLINGTON, who has thorough scientific knowledge of the subject.

Sewers and Sewerage; general observations of interest to all inhabitants of cities and towns, by LOUIS H. GIBSON.

The Money Value of Good Roads; important information in support of the general agitation for the improvement of highways, by PROF. W. C. LATTA, of Purdue University.

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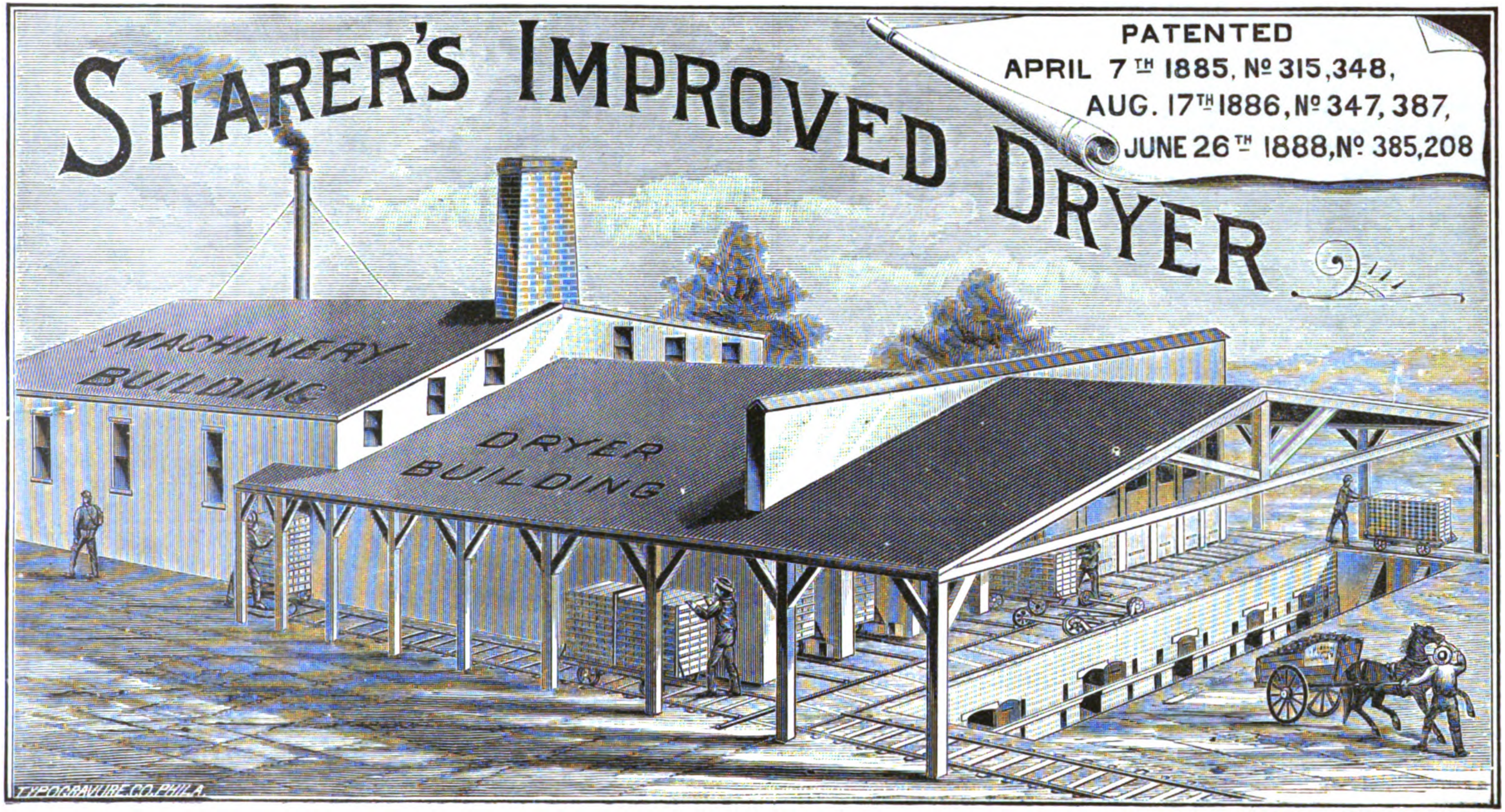

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WE WILL CHEERFULLY GIVE ALL
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81 FULTON STREET, NEW YORK, AND
61 BLYMYER BUILDING, CINCINNATI, OHIO.

Paving and Municipal Engineering

VOLUME IV. JANUARY, EIGHTEEN NINETY-THREE. NUMBER I.

MUNICIPAL EQUIPMENT AND ENGINEERING OF PARIS*.

I.

A GREAT city is an organism which is born, grows, improves or declines as it gives attention, or not, to its material, mental and moral welfare. The health, wealth and future of a city depend upon its engineers as much as upon merchants, law makers and teachers. Paris, with its 3,000,000 people living in comfort and cleanliness, demonstrates the great value of a good municipal engineering plant. Paris is one of the best cities, in some respects the best city, in which to study efficient public works.

To better present the subject, it is best to glance at the history of Paris, keeping city improvements in mind rather than its political development. Many of our American cities are impeded in comfort, convenience, health and beauty by too little study and attention to municipal engineering and by too much attention to political power.

A century before Christ, Paris, then known as Lutetia, was a fishing village. A strong palisade is the first record of engineering work. Caesar's troops conquered the Parisii and their allies at Lutetia and made the town an important Gallo-Roman market place. A monument from that period is now to be seen in the Cluny museum of Paris. About 400 A. D. the Emperor Chlore built a palace and large baths, the extensive ruins being still preserved in the Cluny Square. Old records state that "streets were straightened and covered with Roman pavement," large flagstones of irregular shapes fitted together, and "foot paths were provided with hard earth and gravel." A forum, a church and bridges from the island to both shores were built. Four long roads were finished, one to the English channel, one to Belgium, one to Germany and one to Helvetia or Switzerland. Fragments of the large, smooth, stone pavements of these roads are now put together in the Cluny Museum. Parisii was fortified and withstood the passing tribes of Goths, Burgonds and Germains. Fortunately, Attila, "The Scourge of God," with his Huns, did not besiege Paris.

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Finally, the Franks came, captured it and made Paris one of their capitals. With a part of the wealth captured from elsewhere the Franks built at Paris castles, churches, convents, monasteries and in 886 A. D. rebuilt the walls of the city. Then for the first time a Frankish city withstood a Germanic enemy 30,000 strong. By the year 1000 Paris, having become the capital of the whole Frankish monarchy, gave great attention to the erection of religious edifices, castles, towers and walls. It was extended and divided into three parts, the "*Cité*" on the island, the "*Ville*" on the right bank and the "*Quatier Latin*" on the left bank.

Philippe Augusta about 1200 A. D. added eighty new streets and had rough stone pavements laid on certain streets used by the troops. The Roman pavements had almost disappeared. Most streets were narrow, crooked and ill-smelling. A new wall inclosing Paris, covering 622 acres and requiring thirty years' labor, was finished. Then came a standstill. For 200 years only war due to royal strife was known. The seeds of the future power of the Parisians were sown by the formation of brotherhoods of merchants and manufacturers. These unions established a regular but feeble police, which soon became better than those of the king.

In 1356 Prince Charles called the first council together, twelve nobles, twelve church dignitaries and twelve citizens. His motive was selfish. He desired to get help in raising money for himself and his troops. But the germs of popular will were sown the moment citizens were asked to advise in state matters. The public soon declared through Marcel, a merchant leader, that certain public improvements and reforms were needed. The unlimited power of the French kings was openly questioned. The desired improvements began. Higher schools and an art school were undertaken. A collection of 900 volumes was the beginning of the now famous National Library with so many books and manuscripts that years of labor have not yet catalogued them all. In 1357 a house was purchased and then one built for citizens' meetings. Thus was founded the city hall, which means so much, if in good hands, for the development of a city. Then came the first public theater. Printing came, and the noted National Publishing and Printing Office began its career at about 1470. At this time the population was nearly 125,000. The next important event was in 1529, when the College of France was founded, now so great, with its branches in many cities. The aid to the poor was made a branch of the city business, now so efficient in the bureau of "Assistance Publique." City hospitals were built. Paris was divided for better government into sixteen sections. A law was passed forbidding the houses to project over the streets. Then in 1550 came a special tax and the undertaking of regularly cleaning the streets, a problem not yet solved by most of our cities and hardly undertaken by many.

War came, religious Protestant-Catholic war; worse war can not be conceived. For half a century no peace, no progress. The terrible deed of the Night of Saint Bartholomew, August 24, 1572, caused more than 30,000 deaths and drove from France many of her best builders and artisans. Grass grew over the streets. Thousands of houses were empty; many houses were in ruins.

About the year 1600 came great progress in commerce, manufactures and construction. Carpet weaving and the Gobelin tapestries received an impetus. The handsome bridge Pont-Neuf was completed in 1607. The idea of uniting at Paris the best artisans of all nations crystallized into the "Conservatoire des Arts et Meties," so important to civilization. At this time Paris had for mayor the able man, Miron, who demonstrated the progress a city can make under the right man. He caused to be constructed excellent stone quays, drinking and other fountains and sewers. He widened a few streets and paved many. Paris surpassed other cities of that period, but it was by no means perfected. Most streets were unpaved. Deep mud holes abounded. Police force was weak. Duels constant. Begging and robbery were prosperous. Public parks were reserved almost every day for the nobles. The nobles, shoddy gentility and beggars were one-fifth the population. Religious property covered one-fourth the city. Thus the unproductive classes being so great and not even paying taxes, discontent among tax-payers began and public works ceased. During the two generations of war following the best that can be said is that there was only one period of five months when no man was whipped or put to death for political reasons.

Toward 1700 Paris became quiet. The police were reorganized. The city was cleared of beggars, sharps, thieves, etc.; even the nobility were made subject to arrest if guilty of misdeeds. Street lanterns with candles, 6,500 in all, were introduced. Public carriages and three omnibus lines were undertaken. There were then more than 500 streets. The population was about 525,000.

In 1718, just after the John Law financial fever, the greatest speculation probably the world has ever seen, came the first organized labor strikes, so detrimental to municipal improvement. Previous to placing the names of the streets, in 1728, on the corners, it was only by tradition that the names were preserved. An attempt to number the houses was only partially successful, because the nobility considered it degrading to have their houses known by a number. Merchants were compelled to remove their signs hung over the streets. Oil began to replace candles for street lighting.

The king shortly after 1774 began to realize that more must be done for the public good. In rapid succession arose the military school, the wheat exchange, the mint, the Pantheon, the "Place de la Concorde" and its bridge. Then came a good fire department, many sewers, much paving, several new bridges bringing the two parts of the city into closer connection. Then the private pawnshops were supplanted by the excellent government pawn establishments, of such value to the poor. Little idea can be formed of the immense advantage resulting from the foundation of the great civil engineering school, "Ecole des Ponts et Chaussées," whose graduates have steadily improved, beautified and paved the streets of Paris until they have become the models for the world, besides constructing smooth macadam roadways to all parts of France. These same engineers built the mighty sewers and great water-works of the French capital, besides directing the public works in all its branches. Trained men, above political influence, holding positions for life or during good conduct, carefully tabulate and map every detail of plan and cost of public work, thus enabling their successors to take up the improvements and carry them to even greater success. Engineering statistics and their reduction to units of measurement and cost is a subject sadly neglected in too many of our cities. At the same period were established the schools of mines, medicines, music, oratory, blind, etc. The building of the Chamber of Deputies and several new theaters were erected.

Then came the precursor of the improvement which has been made in so many European cities; the city walls were torn down and used to fill up the moats and trenches outside of them. The space thus gained was converted into broad, handsome boulevards and parkways. About seventy new streets were added to the city. The bridges were cleared of old houses and shops upon them. Whole cemeteries were transferred from about the churches to places far without the city. An immense real estate and building "boom" added several splendid sections to the city. This caused the city engineering bureau to make a profound study of the problems of street network and its relations to the lay of the land, convenience, health, beauty, etc., of the city. The general plan and changes determined upon in 1783 have remained the basis of arrangement and equipment of the streets, avenues, boulevards and parks of modern Paris. The city contained at this time 650,000 people.

Civilization owes much to France, not only for what she produced before the terrible blood-bath of her revolution, but also to her for many results obtained by that revolution. Among other benefits due to the introduction of reforms is that of the metric system of weights and measures now used by all scientists in all lands. After the year 1800 Paris, although provided with beautiful buildings, bridges, etc., suffered because of its poor pavements and lack of sewers. Gutters were generally in the middle of the streets. Oil was still used in street lights. About 1837 gas was introduced. Then a water supply was established for the whole city, better pavements introduced. However, it was not till after 1853 that Paris began a thorough reconstruction of her streets. Hundreds of houses were taken down to make room for new streets and for widening others. Noiseless asphalt pavements were introduced. A grand system of sewers was projected and executed. The municipal engineering department, sustained by an ample supply of funds, has made Paris a handsome, clean and healthful city, the center of attraction for travelers from the entire world.

J. W. Howard.

One of the American engineers who realizes the importance of careful study of city thoroughfares, is Maj. J. W. Howard, of Newark, N. J. He has given careful attention to municipal engineering and for several years has given most of his time to the equipment of streets both above and below ground. In 1881–4 he visited the European cities of importance, even those of Spain, Egypt and Turkey. In the latter, however, there is little to copy, but much to show the importance of good city engineering.

Firmly convinced that vast improvements are needed in the cities of the United States, and that paving is a branch of city engineering the least developed in our cities, he decided to make a specialty of municipal engineering. He visited the principal cities of the United States in 1887 to observe street pavements. He tersely reviews the state of affairs which PAVING AND MUNICIPAL ENGINEERING is endeavoring to improve, when a guest of the Scranton Board of Trade. In an address, afterward published by the board, he said:

"Paving has been regarded by some as not a branch of engineering. So were water-works, so were sewers, so were other branches of public work until, after costly experience, our cities entrusted these things to men who were both practical, scientific and economical.

"The study of the health and progress of a city means to discover how much depends upon street pavements. It means to learn how to make life more agreeable and business more profitable; how to increase the earning power of a city; how to reduce the tax on business caused by poor pavements; how to reduce the number and cost of horses to move our loads; to reduce the cost of repairs to pavements, vehicles and harness; the cost of street cleaning and of excessive sprinkling; also to remove the cost and injury to health and houses, goods and furniture due to poor and dirty street pavements."

Maj. Howard made another visit to Europe in 1886 and additional tours to examine streets in 1888 and in 1892, the last one being made to observe especially the asphalt pavements.

Maj. Howard, in his articles and addresses published in PAVING AND MUNICIPAL ENGINEEING and other publications, shows the importance of increased study of city pavements.

James Waite Howard, the subject of our sketch, is one of a line of industrious Americans originating in England and established at Bridgewater, Mass., about 270 years ago. His forefathers were Puritans. The branch from which he comes has lived for three generations in Maine. His father is Gen. O. O. Howard, United States Army, who, as well as his mother, is from Maine. He is one of five sons and was born at West Point, N. Y., shortly before the civil war, when his father, then a lieutenant, was stationed there as instructor in mathematics. He received his early education in private schools and then entered a high school. By the changes of residence usual to an army officer, his father took the son with him from place to place. Thus the son developed an inclination and ability to compare cities unbiased by local influences and prejudices. Having finished at the high school, he went to Alaska in 1876 and then to Andover, Mass., and graduated at Phillips Academy in the classical course. He followed this up by practical work in railroad construction and tunneling on the West Shore Railroad. Being on the West Point section he again lived with his father, now a veteran officer and in charge of the military academy. His son benefited by his residence at West Point by attending lectures and taking such lessons, being a guest, as seemed of advantage. He then went to France and finished a course of study there. Then, after visiting several German universities, he decided upon a course of higher mathematics and physics at the University of Göttingen, Germany. After his return to the United States and some experience in Nebraska at practical work, he decided that a course of study and a degree of civil engineer from an American institution would put him more in touch with American methods of construction. Because of previous education he was able to shorten the course

of study at the Renssalaer Polytechnic Institute at Troy, N. Y., at which place he graduated with the desired degree.

During his life Maj. Howard has given much time to National Guard matters, and has risen to his present rank by serving in the National Guard of several states. His present commission is in New Jersey, where he resides.

As is usual with men who have had his advantages and improved by them, Maj. Howard is a member of several social and scientific societies. He has a fund of knowledge and many acquaintances in cities at home and abroad. He has gathered many books and pamphlets in English, German, French and Italian bearing upon city engineering, and especially upon street construction and equipment.

PAVING BRICK; DIFFERENCES OF QUALITY.

You ask me to make suggestions that may enable the inexperienced buyers to determine when they are getting good material and how to get it.

The art of making brick in the United States suitable for paving streets is as yet comparatively young, and even those who have been longest engaged in it hesitate to express decided views as to the best manner of manufacturing and burning, or even just what test should be applied to ascertain the grade of paving brick best adapted for street use. My actual experience in this business dates back to less than three years ago, although I confess to several years of investigation prior to that. Readers will therefore bear in mind that I shall endeavor not to be dogmatic, and that in all essentials I am a learner, not a teacher. I shall simply try to give the results of my observations, and admit that my opinions formed upon these results are liable to be changed by further experience.

I have been greatly surprised in reading the numerous letters I have received from persons seeking information on this subject to find so much ignorance of the quality of material necessary to make a good paving brick. While thus far a large percentage of the brick made for street use have been made of what geologists term shale, yet by no means all of them have, or at least very fine brick have been made of material that differs greatly in appearance and analysis from any shale I have ever seen.

In Illinois wherever coal is found shale exists, and so far as my experience goes it is very much alike, but the so-called shale found in Kentucky and Ohio is very different from it. At Cloverport, Ky., where brick are made that are admirably adapted to paving purposes, the material in the bank is largely granulated rather than stratified, and the same is true of much of the material I have seen in Ohio.

At Galesburg we have made up many samples of clay and shale from different parts of the country into brick. One of the most satisfactory of these was a clay from Menominee, Wis. I do not know the analysis of it, but for all practical requirements it was fully the equal of any shale I have ever seen.

This brings me to make my first assertion, viz.: That any material that can be reduced to the consistency of meal, mixed thoroughly with water, made into brick, dried without cracking, and when set in a down-draft kiln thirty to thirty-five high can be burned to a thorough vitrification and retain their shape, will make a good paving brick. The point on which most manufacturers and users of paving brick differ is to decide just what thorough vitrification means.

At our works in Galesburg I could show you six brick, all different, but any one of which seen by itself would be pronounced by experts as a No. 1 paver. Show the whole six at one time and ask the experts which was the best and the fun would begin.

City engineers, city inspectors, manufacturers and contractors are human and their opinions as to the quality of a brick are formed by looking at it, feeling it and perhaps breaking it open, and usually there are as many verdicts as jurors. If these differences are sufficiently wide to necessitate other tests, the chances are that the crushing strength of the brick would be ascertained and some of them put into a machine to test their wearing ability. Neither of these tests is satisfactory or has thus far proven what the qualifications are for the most durable paving brick.

My own opinion is that a brick will stand the wear of street use best when burned just to the point of vitrification, *i. e.*, just before it reaches the brittle point. I also think it will stand a better test for strength and wearing off by attrition when possessed of the toughness which disappears when the brittle point is reached. Thus far we have failed to find out how to get a whole kiln burned just to this point and no farther. If we knew that our theories were absolutely correct there is no question in my mind but that a kiln of brick could be burned with at least 90 per cent. of this kind, but when one city engineer insists on having brick all black burned, as hard as glass, while another insists that he wants none of that kind, as they are too brittle, the poor brickmaker is in despair.

What we want, and what ere long we shall certainly have, is a common sense standard, which shall be a guide. I say ere long; I mean by this when actual wearing tests have been made on streets already paved.

You will see by the above how difficult it is to instruct the inexperienced buyer how to get the best paving brick. Who shall give the instructions? There are certain requisites that common sense and experience will indicate as necessary, but the dividing line between just right and a little less or a little more, is as yet too fine to describe by *D. V. Purington.*

D. V. PURINGTON, the foremost brick manufacturer in the United States, has had a variety of experience, with some adversities, but a greater share of success. He was born in Sidney, Kennebec county, Me., January 22, 1841. He grew up as a farmer boy, attended the common schools and, to use his own words, "kept out of the reform school until he was nineteen years old." Then he taught school until August, 1861, when he entered a New Jersey regiment as a private. He distinguished himself as a soldier, serving until the close of the war, and was discharged from the army in January, 1866, as a captain. He afterwards spent two years in the Freedmen's Bureau in Virginia. In April, 1869, he located in Chicago and embarked in the lumber business, in which he encountered some adversities, and in January, 1872, he entered the employ of Strauss, Hahn & Co. as timekeeper and general utility man in one of their brick yards. He was not long in regaining his foothold and turned to good account the thorough knowledge of the brick business acquired in his experience. He is to-day one of the leading business men of Chicago. He will this year make 90,000,000 common brick in Chicago and 30,000,000 paving brick at Galesburg, Ill., where he has one of the best equipped plants in the country. His plans now contemplate the enlargement of his plants so as to enable him to turn out next year 550,000 common brick daily in Chicago and 300,000 paving brick daily in Galesburg. Physically, he is well equipped for his large responsibilities. He says he "does not remember the time when a physician looked at his tongue or felt his pulse."

FRENCH AND AMERICAN ASPHALT PAVEMENTS COMPARED.

Some time ago the United States government instructed its consul in Paris to look up the question of asphalt pavements, it being generally understood that the French had some peculiar methods of their own leading to the excellence of their work. Soon after I learned of the purpose of the government I began a series of investigations, the results of which have been laid before the readers of PAVING AND MUNICIPAL ENGINEERING. All details of the question of the use of asphalt have been studied and the methods specifically analyzed and published. I now feel that I am in a position to make certain general statements in regard to the question of asphalt both in France and America.

It is proper to say in the first place, that the Americans do not spare any labor, as far as I have been able to observe, in putting down asphalt covering. They certainly use more labor in producing the same result than is common in France. The great difference is in the material. The asphalt which I have seen applied in America is in no way like that used on the streets of France. Here it is a dry, hot, chocolate colored powder. It is not in any sense mastic; it possesses no liquid qualities. It is a thoroughly dry powder. When thrown from a wagon onto a wheelbarrow it dusts over the side. It is distinctly granular and entirely dry. In appearance it is almost exactly the same as powdered cocoa. It is brought to the street where it is to be applied in iron-bodied wagons and spread while yet hot and then pugged by hand into a solid mass.

The asphalt, so-called, which I have seen applied in America, has almost universally possessed certain mastic qualities and has been very dark in color. It has had a sticky quality and been always soft, though slightly granular. It has been not dry, not powdery and altogether has had an entirely different appearance from the asphalts of this section.

The manufacture of asphalt has been described, and no more need be said in that connection at this time. However, it may be well to say, in general terms, that the asphalt of France is a distinctly natural product; that it is pulverized asphalt rock as it is taken from the mines, which has been changed only by being reduced to a powdered state when it is used. They heat it and pound it back into its original state. There is no sand, gravel or other foreign material used in the composition. A little gravel is sometimes sprinkled on the top, though this is not necessary or usual. The process of street making is very simple. After the foundation has been prepared the asphalt in its powdered state is heated and deposited in its proper place, raked out to the proper depth and pugged by hand with heavy iron rammers. The puggers are followed up by men who iron the asphalt with the usual hot irons. Frequently this is all the labor there is attached to putting down the pavement. It is only occasionally that light rollers are used.

It is interesting to notice that the French do not depend on the skill of the rakers and spreaders to preserve a uniform surface. They rake the asphalt as carefully as possible and then run a straight-edge over it in a way to remove all of the superfluous material and bring about a perfectly even surface. Guides for the straight edge to run on are laid in at frequent intervals, say sixteen to eighteen feet apart, and by spreading a little thick and then drawing the straight-edge over the powder an exact and perfectly uniform surface is secured. It depends upon no one's skill in raking to bring about uniformity. This is positively secured by the use of the straight edge.

Something may be said about the mixing of cement. I have noticed at home that cement is frequently mixed on a bed and the ingredients thrown in according to the judgment of some one in charge. In Paris this is altogether a matter of measurement and formula. The judgment of the workmen is not exercised in this matter. It is simply a question of measurement for every part of the mixture. They use in mixing the cement a board floor and bottomless box about forty inches square and twenty inches high. Into this box is first placed some coarse, screened, wet gravel, it having been washed on its way to the mixing bed. This washing is done by placing the screened gravel in wheelbarrows with grated bottoms, through which water can pass when it is turned on at a hydrant. As stated before, this wet gravel is thrown into the box as it rests on the floor, so that it occupies about one-fourth of the inside. On this is spread a small portion of sand and on the top of the sand one-half of the cement, which goes into the mixture. In quantity there is something less than a half a bushel. On top of this cement is another portion of sand, again other gravel, another portion of cement and a covering to the top of sand. After it has been leveled the wood case or bottomless box is lifted off and men with shovels turn the mixture over so as to thoroughly incorporate the different parts. It is then shoveled to the edge of the platform and sprinkled with water at the same time that it is mixed until it reaches the proper consistency. This water is measured out into large sprinkling cans so that the exact quantity is used. Thus there is a uniformity of gravel, sand, cement, water and labor. The formula of handling the mixture with shovels is quite as uniform as the proportions of the mixture. Thus it is clear that nothing is left to judgment. The cement is examined, the character of the gravel and sand known and the mixture prescribed. Then the different proportions are maintained without the slightest variation either in sand, gravel, cement, water or labor; all are exactly uniform. Thé workmen do not in the least have to exercise their judgment.

The grade of the cement bed is maintained in the same way as that of the asphalt. Grade stakes are set at frequent intervals, and from one to the other are fixed rests or guides of wood for a straight-edge. Having filled the space between with a little more concrete than is necessary, the straight-edge is raked over it several times, until all is perfectly smooth and uniform. Thus, when the cement hardens the entire surface is quite as smooth as the most exact floor. There is not the slightest depression or irregularity.

Asphalt covering is largely used for the floors of market-houses, courts, public yards and many other locations of similar character. However, this is quite a different material from the asphalt of streets. This is the same as is used for sidewalks, which is asphalt *coulé*, or mastic asphalt. This material has some of the same general characteristics of the asphalt composition used for paving in America. However, it contains a larger proportion of the bitumen of asphalt, and is softer than the American street composition, this quality being to a larger proportion of asphalt in bituminous form and a correspondingly smaller proportion of sand and foreign material. While the asphalt of the streets is a natural material, asphalt *coulé* is a fabrication ; is a manufactured product.

The asphalt covering which is used for the floors of market-houses and other structures is admirably adapted to cleanliness and sanitation. It is a non-absorbent material, is capable of being worked in such a way that only slight grades or slants of surface are necessary in order to have it drain perfectly. The principal thing necessary to make a successful pavement of this kind is that the concrete foundation, which is usually from four to five inches thick, be rendered quite as smooth as is the final covering.

It can be closely and accurately joined to iron or stone gutters in a way to place no obstruction in the way of perfect cleanliness and good drainage. *Louis H. Gibson.*

Louis H. Gibson is an architect of Indianapolis. His studies of a practical character were conducted in the architects' offices of Indianapolis. His academic education embraced a two years' course in the architectural department, Massachusetts Institute of Technology, in Boston, and fifteen months of technical study and travel in Europe. Mr. Gibson regards his interest in municipal work in its relation to comfortable living, and for that reason not indirectly associated with his work as an architect; the work of the architect being a part of that which has to do with comfortable living, and in its association with good streets, good roads, proper sanitation and other matters affecting the home and the home comforts of the people. During the summer of 1891, Mr. Gibson occupied a part of his time in walking over the roads of France, studying their construction, and gathering literature bearing upon the French system of road construction, taxation, and general organization. The result of his work along this line will be given in future numbers of PAVING AND MUNICIPAL ENGINEERING.

OLD TOWNS AND NEW STREETS.

A GOOD street is a smooth floor suited for noiseless and comfortable travel, and easy to keep clean. The causes of damage are horse-shoes, wheel-tires and water. The greatest of these is water. There is no hope for any kind of a street-floor if it is not well drained, and it is folly to spend any money whatever on a street not properly graded to dispose of surface water. Therefore, before a penny is spent on a street-floor, or even before we determine what the floor is to be made of, we must determine the grades. The whole city system must be provided for in the grade system. It is not enough to provide for carrying the water off of one street and dumping it onto another street. All the water must be carried from all the streets and discharged away from the entire system. All cities have, or should have, a low point in the neighborhood to which all street drainage can flow. Sewers are another matter entirely and have nothing whatever to do with the question of streets. Sewers are house drains exclusively and must not be open to the streets.

Each street has to handle the water which falls on it, and also such water as flows to it on its way to the river from other streets.

A street gutter is therefore at once a drain for its own street and an intermediate canal leading from outlying districts to the river. This being the case it will be at once seen that the duty of a street-gutter and hence the proper grade for that gutter can never be determined by its own street alone. We may even ignore its own street, for if the gutter is properly graded to do its work as an intermediate canal, between other gutters and the river, its own street will not impose serious additional burdens upon it. If, by short-sightedness, we have graded a gutter for a certain duty without proper thought for future town-growth, we will soon find that added outlying gutters are pouring their waters into a set of intermediate gutters never calculated to deal with these waters. This means overflow, and discomfort to travelers, and it means death and destruction to the streets. The remedy is to replan the entire grade system. No good can be done at any one spot or on any one street, or any number of streets less than the whole, and more than that, the lesson of the past must bear fruit in provision for the future. New grades are to be gotten by a little filling and much cutting. Property owners can recover damages if change in established grade does any damage, providing the property is improved property; unimproved property can not recover damages; grade-raising may make damages; grade-lowering can seldom make damages. Hence, grades are to be changed by raising where there will be little or no damage and by lowering at other points, and by short underground drain-connections in rare cases.

The process of arranging for the new grades is as follows: The engineer makes a grade map of present levels, including all outlying areas likely in the future to pass their surface water through the city gutters. He then calculates the quantities of water to pass to the river and makes the most expedient distribution of the flow among the various streets in the system, having in view the present levels and the cost of changes, maintaining old grades where possible without sacrifice. The new levels give him a new grade map which shows the direction and grade of fall throughout the entire system. From this map a description of the grade of each street is written up. This description is passed as an ordinance, which ordinance is to expressly repeal all existing grade ordinances. Thereupon the new grades become legally established.

Then comes the work of bringing the streets to the new grade. It is a cutting process mainly, and may be done slowly, and must begin at the river sides or low points of the finished system. There is no grand upturning and inconvenience, and not necessarily any great expense at once.

When this work is done the streets will, in many cases, be good and satisfactory, the main cause of evil having been removed. But it will very likely be judged expedient, while this regrading is under way, to put upon certain of the streets a better floor-surface than they had before. Then comes the study and the choice between stone, wood, macadam, asphalt, brick, and gravel. But the time for this study and choice has not come yet and will not come till the new grades are established and the work mainly done, and the question of paving will be found of interest only in connection with two or three streets. Nothing could be worse than to pave improperly graded streets, and when the grades are right, a hard surface does not become so important on streets which are otherwise well built, well drained, and well cared for.

The brief of the story is: The streets were good; the grades were bad; the prosperous town has outgrown the flow-capacity of the grades; the streets are therefore going to the dogs; nothing can save them without new grades; with new grades and proper maintenance, the system will be generally satisfactory; a few streets will demand a hard floor-surface, at joint expense of abutters and the general community; the work will then be done; from time to time other citizens will recognize the direct profit of the thing and make similar demands; and eventually the city will find all the street-floors paved. *J. W. See.*

James W. See is an engineer of Hamilton, Ohio. He is one of those who believe that a municipality finds its possessions to consist merely of a piece of engineering constructed at great cost, added to at great cost, and mantained at great cost; and that the too common tendency is to ignore the fact that maintenance should always take the form of betterment in order that an antique structure may conform to modern needs; that money expended in repairing in old lines is often money thrown away; that the greatest burden in municipal taxation lies in this expenditure; and that the burden becomes not only bearable but pleasant, when the expenditures are in the form of betterment which satisfies pride and improves the value of the property burdened by the tax.

MAINTENANCE OF ROADS IN FRANCE.

Maintenance does not mean repair. When a road has been neglected and becomes cut up by ruts, full of holes and bumps, it needs repair. This may be the subject of another article, but here I mean simply maintenance.

Where a road is in a good condition, the surface well drained and perfectly smooth, without ruts or depressions, without dust or mud, when the ditches are clean, that state of thing can always be maintained if the proper care is taken and the proper method is followed; and it is cheaper to maintain a good road at any cost than to let it go to wreck and then repair it.

In a good method of maintenance of a macadamized road there are but two things to attend to: .

First. The continued removal of the worn-out material, either in the shape of dust or mud.

Second. The judicious use of material to replace the wearing out.

Those two operations well made and made in proper time will prevent the tearing up of a road and cause the travel to wear its surface uniformly.

Dust is the stone pulverized; it makes the roads pull hard; it is a nuisance to the neighbors, and is a danger for the road; in fact, when it rains it becomes mud, keeps the macadam moist and soft, which, consequently, is easier cut up by the wheels. When a road is clean of dust, rain-fall drains off fast and the road soon becomes dry and solid, but the mud not only keeps the road wet and soft, but also causes the formation of ruts, and ruts must be avoided at any cost.

For instance, a wagon travels a road covered with mud. It does not attack the macadam, but it leaves a track that will naturally and easily be followed by the next wagon, and by the next, and so on, and if the first wagon did not damage the road the following ones will. If the rainy season lasts long enough the road will then be out of repair, as it is next to impossible to fill a rut without inviting the formation of another one alongside of the first one.

For all well organized systems of roads it will prove to be an economy to carefully remove the dust and the mud.

In old times I have seen the section men, "cantonniers," rake and sweep the dust as well as the mud and it was then considered a paying work. What will it be now that we have street cleaners that can do ten times the same work ten times more economically?

Of course when we come to the practical application of this theory there will be a variety of ways of doing it, according to the climates and the materials we will have to deal with, but the fact will remain the same and it will be seen that if the dust and mud are removed the road can be maintained perfectly uniform and smooth; still it will wear out until it may be entirely removed in the form of dust and mud. To prevent this we have, annually, to replace a quantity of crushed stones equal to the amount of dust and mud removed. *Arthur Lagron.*

ARTHUR LAGRON was born in 1836 in the department of Saône-et-Loire, France. His father being himself an engineer on the public roads, had the son especially educated for that position. He was as early as 1855 in charge of maintenance and construction of roads in the Départmente of La Loire. Then he served a term of five years in the French Army as an officer in a regiment of engineers and fought at the battles of Magenta and Solferino, Italy, in 1859. After that he worked alternately on public roads and railroads in France until he determined to see some new country and came to America. He bought a farm in the south part of Montgomery county, Mo., eighteen miles from the nearest railroad station, where he had all the opportunity a man wishes to make a thorough study of what a farmer loses for the lack of good roads. For the last ten years he has been surveying and building railroads in half a dozen states, but mostly in Missouri and around Kansas City. He has also been city engineer of Chillicothe, Mo., assistant city engineer of Rockford, Ill., where he made a record as a sanitary engineer, and now is in Freeport, Ill., where he is putting in a system of twenty-two miles of sewers.

SPECIFICATIONS FOR BRICK PAVEMENTS.

THE Detroit Board of Public Works has adopted the following specifications for brick pavements in that city:

Old Pavement.—The old pavement to be taken up, and all material and rubbish, including whatever surface dirt may be on the street at the time, shall be removed from the street and disposed of by the contractor, except that the city will reserve such of the best of the material as the board of public works may select and remove from the street after having been taken up by the contractor.

Grading.—The street to be graded to its established grade, under the direction of the board of public works, and to be excavated to such a depth below the true grade as the board may deem necessary for the purpose of receiving ballast for the roadway. The bottom of excavation when completed shall conform to the section or crown of the street as furnished by the city engineer. If there are places in the street which are not firm or properly settled, caused by trenching or connections of sewers, gas or water pipes, the earth must be taken out and the space refilled with broken stone or coarse gravel and pounded to make it solid. In all cases where filling may be necessary to bring the bed to the required height, it shall be done in layers not to exceed six inches in depth, and be thoroughly tamped or rolled to insure a solid bed. None of the earth excavated shall be piled upon the sides of the streets, unless required for filling a low spot at the point where left.

If the contractor shall excavate deeper than the depths shown on the diagram, the depressions shall be filled with broken stone or gravel.

Before placing the ballast or concrete thereon the sub-grade in each block shall be well rolled with a steam roller weighing not less than seven tons; if the contractor does not himself own such a roller, the same to be furnished and operated by the city of Detroit at a cost to the contractor of one cent per square yard. The surplus earth, if any, must be disposed of by the contractor, the said board reserving the right to direct the contractor to remove any earth it may require for the purpose of filling up any low lots, alleys and sidewalks to the proper grade within the assessment district, or for six hundred feet outside thereof.

Tile Drain.—The contractor will excavate a trench twelve inches wide on each side of and beyond the line of the roadway to the depth of twenty-four inches below the established grade. The bottom of the trench to be smoothly trimmed parallel to the curb grade, and have laid thereon a continuous line of well-burned four-inch tile, to be well connected to the receiving basins. Joints are to be well covered with tar paper and the tile covered with broken stone or gravel.

Foundation.—When the roadbed has been prepared as specified above, it will be covered by a layer of concrete six inches in thickness, and prepared in the following manner: The component parts of the concrete will be: One part of freshly burned and finely ground

American cement standing the following tests made by the city engineer: No more than ten per cent. will fail to pass through a sieve of twenty-five hundred meshes to the square inch; when mixed neat with the least amount of water necessary to make a good mortar, it will sustain a tensile strain of not less than sixty pounds per square inch, after being allowed to set in air for one hour, and followed by an immersion in water for twenty-four hours; two parts of clean, sharp lake or river sand, free from clay, loam or vegetable matter; five parts of crushed or broken boulders, granite, syenite paving brick, hard limestone or clean screened bank gravel, the pieces not to be larger than two inches or smaller than one-half inch in any dimension. The sand and cement shall be thoroughly mixed while dry, and then just enough water will be added during the mixing process to make a good mortar. The crushed or broken stone must be screened if necessary to free it from dust, dirt or stone refuse. After being wet with clean water the crushed or broken stone shall be thoroughly mixed on boards with the cement mortar until every piece of stone is completely enveloped by the mortar. The proportions will be fixed by actual measurement. This concrete will be immediately applied to the roadbed, and rammed until the surplus cement mortar appears upon the surface, which latter will be made parallel to the roadbed and in exact accordance with the diagram. No walking or driving will be allowed on the concrete until it is thoroughly set. All defects in this foundation, no matter from what cause, must be repaired or corrected before the work will be allowed to progress.

Cushion.—A cushion coat of clean, sharp sand, well screened and free from all other substances, will be spread over the concrete foundation to the uniform depth of one inch, when well compacted.

Curbing.—Curbing now set upon the streets to be taken up, rejointed and reset to the proper line and grade wherever directed. New curbing to be set wherever ordered, and must be of the best quality of Medina, Hammond, Berlin Hights or Berea stone, and to be of the following dimensions: Medina, four inches thick and not less than three feet long; Hammond, four inches thick and not less than four feet long; Berlin Hights, four inches thick and not less than four feet long; Berea, four inches thick and not less than four feet long; all to be eighteen inches deep; stones to be flat tool or crandle dressed, true and smooth; with close joints at the end, at least fifteen inches below the top of the curb, and shall have a straight and even face on the side towards the gutters to the same depth as end joints; top to be dressed to a straight line, and to a one-fourth-inch bevel in five inches, and to a uniform thickness of four inches, and brought to a straight line on top and face by use of a straight-edge. Stones to be taken out of wind, and to be cut with a three-fourths-inch flat tool-draught on upper edge of face, stones to be set with close joints to the true line and grade of the street, and settled into place with a paver's rammer, and the sand, in front and rear, tamped with a heavy hand-tamper to the full depth of the stones. Curbing to be jointed and set as directed around curves and corners at same price as for straight work. All junctions at street corners will be set as a true segment of a circle of four feet radius, in one piece, except Medina stone, which may be in two equal segments. The curb to be set in a bed of properly compacted sharp, clean river or bank sand, and backed up with the same material to the full depth of the curb and width of excavations, and well tamped down. Back-filling to be done by the contractor a distance of three feet from the curb, where the top of the same is above the natural surface, and all to be left in a neat and sightly condition.

Paving Brick.—Shall consist of the best quality of sound, hard-burned paving brick, made and burned specially for street paving purposes, and shall stand all reasonable tests as to durability and fitness, to which paving material is usually subjected. All bricks to be square-edged and straight, free from cracks and other defects and of uniform size, and of a quality to be approved by the board of public works, and equal to the approved samples in its office.

Kind of Brick Bid Upon.—Each bidder shall state in his bid the kind of brick that his proposition is based upon, which must be of such kind as has been approved by the board of public works, and the brick to be used upon the street under such contract shall be equal in every respect to the approved sample in the office of the board. Each kind of brick bid upon shall be a separate bid.

Statement.—Each bidder shall also, if required, furnish a statement showing the proportion and kinds of material used in making the brick and the manner of making and burning the same.

Inspection of Brick.—All bricks to be open to thorough inspection by the board of public works and its agents, both before and after laying, and all rejected material shall be immediately removed from the street and the deficiency made good by the contractor, and he shall at all times provide, at his own expense, a sufficient number of men to assist the board of public works and its inspectors in the proper inspection and culling of the bricks.

Manner of Laying.—Upon the cushion, when prepared as heretofore specified, the paving bricks are to be laid in the following manner: The pavement is to be constructed with a single layer of brick laid on edge, end to end, in right angle courses across the street, as the board of public works shall direct, except at street intersections, where the courses are to be placed at such angles as the board shall designate. The bricks are to be set in straight courses across the street, with the body of the bricks close together, sides and ends touching, and breaking joints at least two inches with the bricks in the adjoining courses; they are to be set perpendicular with the grade of the street and to a height of from one-quarter to three-quarters of one inch, or to such other height as the board of public works may direct, above the true grade and crown of the street when finished, to provide for settlement in pounding and rolling. Nothing but whole bricks shall be used, except in starting a course or in making a closure at curbs, catch basins and street structures, when not less than half bricks may be used in breaking joints, which shall be made tight and close at ends. Great care shall be taken in breaking and trimming the bricks for this purpose, so as not to check or fracture the part to be used; all joints to be broken or cut at right angles to top and sides of the bricks. The breaking and trimming must be done by experienced men working with proper tools.

Defective Bricks.—All soft, cracked or defective bricks found in the pavement any time before its final acceptance shall be removed by the contractor and the place made good at his expense.

Rolling and Tamping.—The paving, when laid as specified, and either before or after the filling of the joints and top dressing is put on, as the board of public works may direct, shall be thoroughly rolled three or more times lengthwise of the street with a steam roller weighing not less than seven tons. All parts of the pavement which can not, in the opinion of the board of public works, be properly rolled shall be thoroughly rammed not less than three times, in such a manner as the board of public works shall direct.

Cement Filling.—The joints will, as far as possible, be completely filled to the bottom with a cement composition of not less than ten per cent. of refined Trinidad Asphalt, mixed with coal tar cement distilled at a temperature of not less than 600 degrees, Fah., and the whole mixed with such proportion of still-wax as not to soften or become brittle under heat or cold.

Top Dressing.—The composition shall be heated and used at a temperature of not less than 300 degrees, Fah., to be determined by a proper gauge or indicator placed upon the tank used in the street; extra material and care shall be used at the gutters in filling all joints in both paving, curbing and around catch basins or other receptacles, to effectually prevent the leakage of water into the sub-roadway; all joints to be completely filled to the top, and refilled such number of times thereafter as may be directed before adding top dressing. The cement not to be used until the brick are completely dry. The surface of the paving, when completed as above, shall be covered with a half-inch top dressing of clean, coarse sand or gravel, of approved quality, which, with all accumulations, shall afterward be removed from the pavement by, or at the expense of the contractor, at such time as the board may designate before the final acceptance of the work by the board of public works, and the pavement left clean for inspection.

The price bid for the paving to include all labor and material, ballasting, filling, top dressing and tamping necessary in the preparation of the sub-grade, and in the treatment of the paving when laid, including the composition to be used in filling the spaces between the blocks.

Marginal Finish.—There shall be set at the edge of the brick pavement where it crosses any intersecting street or alley a line of retaining stone of the same quality as the curbstone. These stones shall be four inches thick, not less than eighteen inches deep, and not less than three feet long, and conform to the surface of the pavement with their exposed edge.

Orders to be Obeyed.—Whenever the contractor is not present on the work, orders will be given to the superintendents or overseers who may have immediate charge thereof, and shall by them be received and strictly obeyed. And if any person employed on the work shall refuse or neglect to obey the directions of the board of public works, or its duly authorized agents, in anything relating to the work, or shall appear to the said board to be incompetent, disorderly or unfaithful, he shall, upon the order of the board of public works, be at once discharged and not again employed on any part of the work.

Defects Before Acceptance.—All settlement, defects or damages in any portion of the pavement, by public travel, rain, snow, ice, frost, or other causes, before the final acceptance of the work by the city, shall be repaired and made good at the contractor's expense. All rubbish which may accumulate during and by reason of the work herein provided for, shall be removed by the contractor as fast as the pavement is laid, and the street left clean and in good condition.

Material on Street.—Material delivered on the street, either before or after dressing, to be neatly and compactly corded up along the sides of roadway, in such manner as to cause the least inconvenience to property owners and to the general public. Private drives and street crossings to be kept open. Shade trees, sidewalks and other improvements shall be protected by the contractor from all damage by stone or otherwise.

Obstructing Travel.—Travel upon the street, or upon any intersecting street or alley, shall not be hindered or inconvenienced needlessly, nor shall any portion of the roadway or street be opened up, nor shall the same be wholly obstructed without the direction of the board of public works, in which latter case the contractor shall cause plain and properly worded signs, "Streets Closed," announcing such fact, to be placed, with proper barricades, at the nearest cross street, upon each side of such obstructed portion, and upon intersecting streets, where travel can pass around the same in the shortest and easiest way.

Colored Lights.—Colored lights, and, if required, night watchmen are to be maintained, at the expense of the contractor, when necessary, to prevent accident.

City Rights Reserved.—The city reserves the right to lay or relay any or all necessary gas, water or sewer pipes during the progress of the work, or to build or rebuild any catch-basins, sewers, cisterns or street railroad tracks.

Guarantee.—The contractor will furnish a five year guarantee for his work, without extra charge. The guarantee to be of such form and nature as the board of public works may direct.

If at any time during the continuance of said guarantee the pavement should be opened for the purpose of putting in the street sewers, gas pipe or water mains, or repairing the same, or for any other purpose, the contractor shall relay said pavement at a cost of ten per centum above the original price, and when said pavement is relaid and restored, said guarantee shall extend to the pavement so relaid and restored for the balance of the time for which said guarantee is to continue, and in no case where it shall become necessary to disturb said pavement for any of the purposes above mentioned shall it be deemed as releasing said contractor from said guarantee.

Inspection.—The work shall at all times be subject to inspection by the city as the work progresses, but such inspection shall not relieve the contractor from any obligation to perform said work strictly in accordance with these specifications, and work not so constructed shall be removed and made good by the contractor, whenever so ordered, without reference to any previous oversight in inspection.

Assignment of Contract.—The first party shall not assign or transfer this contract or sublet any of the work embraced in it, without the consent in writing of the board of public works being first obtained.

Work and Forfeits.—The work embraced in this contract shall be begun within one week after written notice so to do shall have been given to the contractor by the board of public works, and carried on regularly and interruptedly thereafter (unless the said board shall otherwise, in writing, specially direct) with such a force as to insure its full completion within............thereafter; the time of beginning, rate of progress and time of completion being essential conditions of this contract. And if the contractor shall fail to complete the work by the time above specified, the sum of twenty-five dollars per day for each and every day thereafter, until such completion, shall be paid to the city of Detroit through the board of public works before acceptance of the work.

Protection for Labor and Material Supplied.—The contractor, for himself or for any sub-contractor under him, shall well and truly pay, as the same may become due and payable, all indebtedness which may become due to any person, firm or corporation on account of any labor or material furnished in connection with the contract of which these specifications form a part; and in case of his failure so to do, and on written notice of any unpaid claim for labor or material as above being filed with the board of public works, a sum of money sufficient to cover such claim or claims shall be retained from any moneys due or to become due said contractor on his contract, and if such claim or claims be fully substantiated to the satisfaction of the board of public works, said board shall pay such claim or claims from the moneys so retained, any residue to be paid such contractor on the completion of the work.

Proposals.—The city reserves the right to accept or reject any or all proposals made under these specifications at any time within thirty days after the same are received.

PLANTING TREES IN THE STREETS.

THE question of trees in the streets is, or at least ought to be, of interest to every town-dweller, for it is only in trees and grass plats and occasional climbing vines that he is able to get a glimpse of the country, which seems to many to be man's natural birthright. It is a good sign that there is a growing taste for the cultivation of the beautiful Japanese ivy, which will grow so luxuriantly on the front of a brick or brownstone house, and requires the smallest possible amount of attention. Give it a rooting place in good, rich soil, and nature does the rest. In two years or less your house will be half covered with the rapidly growing climber, and in a little longer time it will be completely embowered in it. The cost is only a trifle, and this ivy, or ampelopsis, is absolutely free from objectionable features.

In the scanty soil which trees are likely to get in paved streets, they necessarily have a hard time. Nevertheless with a little care they may be made to thrive and do well. Lowell has said:

> Who does his duty is a question
>   Too complex to be solved,
> But he, I venture the suggestion,
>   Does part of his that plants a tree.

How many city dwellers have performed this part of their duty? Not so many as the lover of trees would be glad to see do it.

On the general subject of street tree-planting, Colonel John Y. Culyer, the well known landscape architect of Brooklyn, talked in an interesting way the other day. "I notice," said he, to a New York *Tribune* reporter, "a spasmodic revival of interest in street trees during the lax summer season, if indications in the papers are correct. I have on several occasions called attention to the matter. In my opinion the failure of large numbers of street trees to thrive is to be attributed primarily to lack of intelligent interest in street tree-planting, and, in the second place, to general neglect. Trees planted in our city streets even under the most favorable conditions must of necessity be compelled to grow amid many disadvantages. The principal causes of failure, so far as they may be understood by non-professionals, may be briefly enumerated as follows: First, the selection of the tree; second, planting, and third, maintenance.

"For street planting only a few varieties of trees are at all available. Of these the family of maples supplies the best resource, since maples will grow under discouraging circumstances and are especially suitable for our purpose, being clean, long-lived, and tractable; moreover, they will respond to the smallest help, being, as it were, solicitous to please and to show an appreciation of human attention. No one who understands trees will be surprised that I speak in this way about the maple. Of the various kinds, the silver or white-leaved maple grows the most rapidly, and is perhaps the least desirable; but nevertheless it is far superior to some kinds of trees used for street planting. The sugar maple, the Norway maple, the sycamore maple, the scarlet maple, and even the finer varieties, such as the cut leaf, etc., will all do well, and if nourished and properly cared for are less likely to be infested by insects than almost any other kind of a tree. The aimable elm needs moisture, but will flourish in clay, or in a rich, loose soil. Then there are the English and American lindens, which require a certain pruning in growth to adapt them to street purposes; the Carolina poplar and the ailantus, the latter of which grows rapidly, but is not specially desirable.

"There is a craze for planting large trees—say from four to six inches in diameter—both in streets and upon lawns. In eight cases out of ten, to be conservative, under the ordinary conditions of removal, they fail. The safe rule is to go to a reputable nurseryman, select under his guidance a well-formed, perfect tree two or three inches in diameter, with a full natural head and fibrous roots, pay him his price for it, and then plant it properly. The chances are that in these circumstances success will follow. It is a crime to cut off the top or natural head or leaders of a young tree, since its chances of attaining perfection and permanency are thereby impaired, if not destroyed. After selecting a tree such as I have described, dig a pit at least four feet square and as many feet deep, fill it with good loam or soil, plant the tree in this, placing it as to depth just to the point where the trunk leaves the main roots. This is the natural and proper depth. Spread the roots out lightly and evenly, fill in the soil carefully, and finally cover the whole compactly; and behold, the tree is planted.

"Next as to maintenance. In the first place, leave a space at least equal to three feet in diameter uncovered by flagging and open to the sunlight, the winds and the rains. Apply each season, in the fall and spring, a little surface stimulation, such as would be afforded by well-rotted manure or some artificial fertilizer. In the spring pick up the soil loosely around the tree and mound it up lightly, so that too much moisture shall not penetrate to the roots. Be sure to protect the bark from injury; and I am tempted to advise the tree-owner to shoot any horse that nibbles the tree, or to use drastic measures in dealing with its owner. Keep up this course of treatment, and the chances are that the response of Nature will be entirely satisfactory. What is worth doing at all is worth doing well, and the rule is particularly applicable to the subject in hand.

"Now, what is the matter with many of our older trees? Well, the general answer may be given in one word—neglect. They are being supported on poor-house fare. They have outgrown their supply of nourishment and likewise their environment; they are craving food. In short, they are starving. Take up the flagstones that confine and coffin them; dig up the earth around them; fertilize them, and many of them may yet be restored and enjoy a vigorous life. Others, too long neglected, will gradually die. Many trees also want prudent pruning, thinning out of dead and surplus wood. For my part I would be glad to give advice gratis in order to save a good street tree. New streets in our cities ought to be planted properly in the beginning, and thus in time they will become pleasantly shaded thoroughfares."

UNDERGROUND WIRING FOR ELECTRIC RAILWAYS.

In a discussion on underground wiring for electric railways, at the Cleveland meeting of the American Street Railway Association, Mr. Pearson, of Boston, said, that while the ordinary method of returning the current through the rails and supplementary wire would be sufficient in small towns or where there are few cars running, on large roads where the traffic is heavy, more return grounds than have been used heretofore will have to be installed. It was found in Boston that from a lack of return feeders there was a great deal of electrolytic action on the supplementary wires, and as a remedy a large amount of overhead copper is being put up for returns. It was not thought advisable to put it underground on account of the rapid corrosion, and there is no advantage in using iron on account of the low conductivity. In regard to using the trolley wire as a positive or a negative, he originally ran the positive current through the trolley wire, but found that the action on the supplementary wire was too great, and changed it and put the negative to the trolley wire. This merely transferred the action to another point.

In answer to a question regarding trouble with water pipes, Mr. Pearson said that he did not remember any particular trouble with water pipes, but if there is a large current passing through the earth it will take hold of any convenient pipe, and there will be electrolytic action. In any large railroad system, if the attempt is made to use the earth for return ground by putting in ground plates in driven wells, or elsewhere, and a good metallic circuit is not provided for the return current, the current must inevitably injure the water pipes and all other pipes. The current when it leaves the cars goes into the ground, and taking a water pipe may go a mile on that pipe and then leave it for a better conductor; the result being that the pipe will be corroded at this latter point.

Mr. Richardson, of Brooklyn, asked in regard to using old rails as returns by putting them in the ground, using five or six or more, side by side and so making a continuous path for the return circuit, proper fastenings being provided.

Mr. Pearson thought it would be difficult to make a good joint, and that without it there would be heating and corrosion, and that a copper joint would not do as there would be electrolytic action under any circumstances. It was attempted in the early days of electric railroads to use the rail for the return conductor without putting in supplementary wires, and found almost impossible to maintain a joint of any sort. When a large current is passed through a joint oxidation takes place, and the joint soon becomes worthless. This condition will exist no matter how large the joint is made, and if dissimilar metals are used a local electrolytic action will also take place.

In answer to another question Mr. Pearson said that they had used a considerable quantity of old steel and iron cable, in getting across rivers and connecting supplementary wires, but that it cut away very rapidly. For instance, in one place seven cables were put in with thoroughly soldered joints, and in less than four months they were entirely gone.

Mr. F. S. Holmes said that he had the opinion of an engineer experienced in street railroad work, to the effect that when there was a sufficient number of ground plates along the line the current was about equally divided between the rail return and the ground wire. The construction we have to-day, where ground plates are used for return currents, makes the trolley wire and the various plates and supplementary wire along the line of the road positive and the large ground plate at the station negative. This is wrong, because the supplementary wire and ground plates along the line are rapidly corroded, while the negative plate at the station is uninjured. The conditions should be reversed, the station plate being made positive and the line plates and supplementary wire and trolley negative to it. Corrosion will then be largely confined to the station plate, which can be easily replaced. To accomplish this the current must, of course, flow out by the ground, which will be positive, and back by the trolley wire, which will be negative.

THE NEW JERSEY ROAD LAW.

THE laws of New Jersey are now well calculated to encourage the building of good roads in that state. The policy as embodied in recent enactments on this subject is the most liberal and progressive in the Union. The law passed by the last legislature perfected and enlarged the systems attempted to be carried out in the act of 1891, but which became inoperative by reason of the failure of the legislature to provide for the appointment of a state commissioner of agriculture. By the act of last winter the duties devolved upon the latter named official are placed upon the president of the state board of agriculture.

The law as it now stands provides that whenever a petition signed by the owners of two-thirds of the lands bordering on any public road or section thereof, not less than one mile in length, shall be presented, praying the board to cause such road to be improved under the provisions of the act, it shall be the duty of the board to cause such improvements to be made.

The estimated cost, however, of all improvements made in any county in any one year shall not exceed one-half of one per cent. of the ratables of the county for the preceding year.

One-third of the cost of all roads constructed under this act shall be paid for out of the state treasury, providing that the amount so paid will not exceed $75,000 in any one year. The $75,000 set apart for this purpose shall be apportioned by the governor and the president of the state board of agriculture among the counties of the state applying therefor, in fair pro rata proportion to the cost of the roads constructed in each.

Two-thirds of the cost of the roads thus constructed is to be borne by the county, and the county board of assessors are required to include the sum in the county taxes assessed for such year, and the same shall be assessed, collected and paid over to the county in the same manner and within the same time that other county taxes are paid.

The adjoining property owners may be assessed for benefits to an amount not exceeding ten per cent. of the entire cost of the improvement.

Any road thus constructed shall forever be a county road, and the duty of keeping it in repair shall forever devolve upon the county.

The provisions of the New Jersey laws, it will thus be seen, place the main burden of constructing the improved road upon the state and the county, relieving the adjoining property owners of all but the possible assessments of only ten per cent. of the entire cost.

Movements are in progress in different parts of the state to fulfill the conditions upon which the state appropriation of $75,000 may be secured.

CURRENT INFORMATION.

COST OF WATER-WORKS IN SMALL CITIES.

Many water-works plants are being established in cities of from 5,000 to 10,000 population, and there is a general demand for information as to the probable cost of such plants. The best information on the subject can be gathered from the following statistics:

Alliance, Ohio, population, 6,130; private company; source, Mahoming river; pumping capacity, 3,000,000 gallons; mains, six miles; cost, $145,000; hydrant rental, $60.

Ashtabula, O., population 10,000; private company; source, wells near Lake Erie, two miles distant; pumping capacity, 3,000,000 gallons; mains, 14 miles; cost, $320,000; hydrant rental, $45.

Bellefontaine, O., population, 5,000; municipal source, flowing wells; pumping capacity, 1,500,000 gallons; cost $100,000, 6 per cent.; total annual revenue, $2,000, making an annual loss or cost for hydrants, $5,800, allowing $1,800 for operating expenses.

Bucyrus, O., population 7,000, private company: pump capacity, 2,000,000 gallons; mains, 12 miles, wooden pipes; cost, $108,000; hydrant rentals, $55.71 for first 70, $40 for each additional.

Crestline, O., population, 3,000; municipal, source, springs, gravity; mains, nine miles; cost, $100,000; annual net revenue, $1,200.

Defiance, O., population, $8,500; private company; source, Maumee river; mains, 13 miles; cost, $175,000; hydrant rental, $40.

Delaware, O., population, 9,000; private company; source, wells and springs; main, 18 miles; cost, $200,000; hydrant rental (206 hydrants), $38.

East Liverpool, O., population, 7,500; municipal, source, Ohio river; pump capacity, 1,500,000 gallons; mains, 16 miles; cost, $151,000; operating expenses, $5,000.

Sault St. Marie, Mich., municipal, population, 8,500; source, river; pump capacity, 1,500,000; mains, six miles, small pipe; cost, $50,000, 6 per cent.; operating expenses, $4,500; interest, $3,000; total, $7,500; receipts, $2,500. The city pays itself, therefore, for hydrant rental $5,000 annually for 50 hydrants without making any provisions for a sinking fund.

West Bay City, population, 10,000; municipal sources, river; pump capacity, 3,000,000; main, 13 miles; wooden pipe; cost, $75,000; revenue from consumers, $2,500; annual operating expenses, $6,000. Its 111 hydrants therefore cost the city $8,000 annually, or nearly twice as much as the water supply company propose to charge for the same number of hydrants and better pressure.

Ypsilanti, population, 7,000; municipal sources, wells in drift gravel; pump capacity, $2,000,000; mains, 17 miles; mostly small; cost, $140,000.

Monroe, Mich., population, 6,500; private company; source, Lake Erie, mile and a half; pump capacity, 3,000,000; mains 15 miles; cost, $150,000; hydrant rental, $46.90.

Warsaw, Ind., population, 4,000; private company; source, lake; pump capacity, 2,000,000 gallons; mains, five and a half miles; cost, $95,000; hydrant rental, $50.

Wabash, Ind., population, 9,000, private company; pump capacity, 2,000,000 gallons; mains, 12 miles; cost, $175,000; hydrant rental, $45.

Valparaiso, Ind., population, 6,500; private company; pump capacity, 1,500,000; mains, 12½ miles; wooden pipe; cost, $100,000; hydrant rental, $80 and $50.

Mt. Vernon, Ind., population, 5,000; private company; source, Ohio river; pump capacity, 2,000,000 gallons; mains, nine miles; cost, $100,000; hydrant rental, $46.66.

The logical deduction from the foregoing is that water-works systems generally cost in cities of from 5,000 to 10,000 inhabitants more rather than less than $100,000, even where the source of supply is close to or within the city; also that tax-payers generally have to pay as much for fire protection in interest and operating expenses above revenue as they would have to pay a private company for the same service in the shape of hydrant rental. In the cases cited the municipal water-works have no private companies to compete with them.

POLLUTION OF STREAMS BY SEWAGE.

A remonstrance having been filed by a number of citizens of Indianapolis against the emptying of sewage into Fall creek, a stream passing through a part of the city, though the public water supply is not taken from it, the question as to pollution of the water was submitted by City Civil Engineer Mansfield to Prof. C. T. Chandler, professor of chemistry of Columbia college, one of the best and most eminent authorities on water analysis in the United States, who made the following reply:

"In reply to your favor I would say that I should not hesitate for a moment to allow these 150 houses to be connected with the drain which has to discharge into the stream that runs through the city. I do not think the amount of sewage which they would deliver would have any appreciable effect on the character of the water in that stream, considering the fact that the water is not to be used for drinking purposes.

"I will inform you further, that the city of Albany has now been drinking the water of the Hudson river for twenty years without filtration, and that it is one of the healthiest cities in the United States and has been so during this entire period of twenty years, notwithstanding the fact that the city of Troy, eight miles above, drains into the river, with a population of about 60,000, and that several other towns drain into the river above Albany."

To what extent a stream may receive sewage without becoming a nuisance, though unfit as a source of water supply, may be seen by the following:

"In pollution of water of the Blackstone river, in Massachusetts, which receives the sewage of Worcester (report of Massachusetts board of health), the following estimates of the sewage entering the stream are given:

Sewage of Worcester (minimum amount)	2,000,000 gal.
Sewage of mill operators	36,000 gal.
Fluid refuse of mills (estimated)	2,500,000 gal.
Total	4,536,000 gal.

"The dry weather flow of Blackstone, including sewage, is taken at 5,961,000 cubic feet per day. In this case we have 5,365,092 of unpolluted water, mixed with 606,508 cubic feet of badly polluted water, or 10 per cent. of the water in the stream is sewage. This stream, in 1875, was not considered a nuisance."

Comparing this percentage with that which would be found in Fall creek after 170 houses connect with it, *i. e.*, one part in 18,000, or .006 of 1 per cent., we see how little effect the small amount of water would have on the stream.

"Sewage diluted with twenty times its volume of water and running a distance of ten to twelve miles, will be destroyed." Other authorities state that it will be destroyed in three miles.

RAPID TRANSIT IN NEW YORK.

The result of two years' research and deliberation on the part of the New York Rapid Transit Railroad Commission has been given to the public in a report, advocating an underground railroad traversing New York in the lines of greatest travel, with ramifications and side tracks to less traveled portions of the metropolis. The plans call for a four-track electric railway, with a total length of fifteen miles, the main line of which is to run from the Battery through Broadway and the Boulevard to Fort George, and thence northward to Yonkers. The road will be 44 feet wide and 11½ feet high. Both local passenger and express trains will be run on scheduled time at a 5-cent passenger rate. There are contemplated 35 stations for passengers, and 10 express depots. There will be two loops, one from Broadway at Bowling Green to South Ferry, and back through Whitehall street to Broadway, and the other from Broadway around City Hall Park to the bridge entrance. The underground portion extends only to Forty-third street. From thence viaducts, half-sunk tunnels and bridges will be used. All the stations below Manhattan street will be underground.

The specifications state that the load to be supported by the underground construction shall be estimated as 1st, weight of soil and pavement, 2d, weight of pipes and other structures beneath the pavement, 3d, weight of roof, 4th, live load on the street, total to be assumed at not less than 1,500 pounds per square foot of surface.

Electricity must be used, and the motors shall be sufficiently powerful to readily start a train of eight cars weighing, loaded, not less than 30,000 pounds on a gradient of 1½ feet in 100 feet of distance. The motors must maintain a speed of not less than 40 miles an hour. Should each car carry its own motor the above requirements must be in proportion. The rails are to be 75 pounds to the yard, and block signals are to be used.

The franchise is to run 999 years, and the company must have a capital stock of $50,000,000 in $500,000 shares. The company must protect the city in $2,000,000 bonds, finish the road, pay 10 per cent. of the receipts, and pay out anywhere from $75,000,000 to $100,000,000 for the road.

The commissioners who have completed this task are: President, William Steinway; vice-president, J. H. Starin; J. H. Inman, Samuel Spencer, and secretary E. L. Bushe. The engineers most prominent are John Bogart and William Barclay Parsons.

ANNUAL MEETING OF BRICK MANUFACTURERS.

Indications are in every way favorable for a successful meeting of the brick manufacturers at Louisville, beginning Tuesday, January 24. The Louisville brickmakers have made very complete arrangements for the entertainment of the visiting members of the national association, including probably a banquet, a drive around the city and a trip to the Mammoth Cave or the vitrified-brick plant at Cloverport, Ky. Committees were appointed as follows: Arrangements—A. L. McDonald, Phil Donahue and F. E. Hebden, of New Albany. Finance—F. W. Manly, Harry Demusnil and Albert T. Bemis.

Among the papers to be presented to the Association during its sessions are the following:

"Burned Clay," L. J. Howard, St. Louis, Mo.; "The Professional Brickmaker," Jos. Fairhall, Grape Creek, Ill.; "The Mistakes of Brickmakers," general discussion, led by a member of the Western Pennsylvania Brick Exchange, Pittsburgh, Pa.; "Association Among Brickmakers," Alexander Prussing, Chicago; "Manufacture of Brick from Shale by the Dry Press Process," by J. R. Figh, Dallas, Texas; "The Evolution of the Brick Machine," Cyrus Chambers, Philadelphia; "Old Fogy Brickmaking," E. O. Glidden, Boston; "How Best to Dry Brick," general discussion, led by D. G. Rhoads, Omaha; "Enameling Brick," Isaac Hardy, Aberdare, Eng.; "Paving Brick—Their Manufacture and Use," W. S. Williams, Canton, Ohio; "Burned Clay as a Roofing Material," John R. Elder, Indianapolis; "Front Brick —Their Relation to Architectural Design," James Taylor, New York, N. Y.; "The Fuel Question," general discussion; "Vitrifaction of Clays," A. L. McDonald, Louisville.

METHOD OF MAKING HARD BRICK.

In the western parts of Mongolia there are such rapid alterations of temperature that ordinary bricks and even the usual building stones disintegrate very rapidly. The inhabitants of that country have a process for making extremely hard bricks, sonorous, and having the appearance of trachyte. The article by Mr. E. Blanc in *Dingler's Polytechnisches Journal* describing the process does not inform us as to the exact constitution of the clay. The brick kiln is in the shape of a vertical cylinder, surmounted by a dome. There is a rather wide hole in the top of the dome, and during the first part of the process the hole is left open. Three draught chimneys built inside the furnace open outwards at the height of the dome and are kept closed with clay at the beginning of the operation. The kiln is heated for three days during the first part of the process, and then the hole at the center of the dome is gradually reduced in size by means of blocks of moistened clay. The flame is allowed to die down and the small hole remaining is covered with wet felt. The felt is covered with sand, which is continually kept moist. The three lateral chimneys are then opened and the fire lighted again. The draught is thus reversed and the second stage of the process thus commenced lasts for four days. During this time the water from the felt is heated and fills the kiln with an atmosphere of superheated steam. At the beginning of the second part of the process the bricks have light red color and this changes to uniform dark gray. At the end of four days the bricks are completed.

WOOL USED FOR A BRIDGE FOUNDATION.

When the National pike bridge, west of Richmond, Ind., was in process of construction, the workmen at the west side of Whitewater river dug down to find a solid foundation. They struck a great and seemingly bottomless bed of quicksand. Vainly they labored to find a safe resting place for the foundation. Finally the civil engineer and the contractor struck on a novel expedient to overcome the difficulty. They sent men all through the country to buy wool. They purchased nearly all of that commodity in adjacent counties, and the primitive woolen mills were compelled to pay high prices in order to procure anything to work on. This wool, unwashed, burrs and all, was delivered on wagons of all sorts. It came piled high, on beds constructed for the purpose, and all was tumbled into the hole intended for the foundation. As pressure was applied it sank some distance into the sand, but finally it would sink no further. At last, on this woolly foundation, the rocks were laid, and to-day the western abutment of the old national bridge rests on a bed of compressed wool.

INDIANA ENGINEERING SOCIETY'S ANNUAL MEETING.

The thirteenth annual meeting of the Indiana Engineering Society will be held in South Bend, January 24-26. Mr. Everett B. Vawter, of Lafayette, the corresponding secretary, in a letter to Paving and Municipal Engineering, says that the programme is not yet complete. "You may announce, however," he says, "that we have promise of the best meeting in the history of our organization, and papers will be read by men prominent in the various departments of the engineering profession, as well as those identified with the principal educational institutions of the state. Among the names that will appear on the programme we might mention: Prof. A. E. Phillips, Purdue University; Prof. M. A. Howe, Rose Polytechnic; Prof. M. J. McCue, Notre Dame University; Jno. W. Fawcett, C. E., Delphi; Calvin Carter, C. E., Brookville; A. W. Smith, C. E., Kokomo; Thos. Finley, Shelbyville; J. F. O'Brien, surveyor Putnam county; M. A. Ruder, C. E., Monticello; Wm. M. Whitten, city engineer South Bend; J. F. Merghan, assistant city engineer South Bend; E. M. Culp, city engineer Anderson; R. I. Morrison, C.E., Knightstown; L. S. Aller, C. E., South Bend; Jno. W. O'Bannon, city engineer Elwood; Jno. E. Alter, county surveyor, Rensselaer; Wm. P. Carmichael, C. E., Williamsport; F. Hodgman, Climax, Mich. The subjects to be treated are: Street pavements, sewer construction, drainage, bridge work, public roads, legislating, etc."

STREET INDICATOR FOR ELECTRIC CARS.

A street indicator for electric cars has been tried recently by the Albany Railway Company, of Albany, N. Y. A similar method of announcing the names of cross streets, used for a time on the South Chicago cable roads, was worked by the gripman, and it was found to be more than the gripman could attend to. The Albany indicator is placed inside the car over the door, and consists of a series of narrow signs so arranged that only one is visible at a time. The indicator is operated automatically by a current from the trolley wire. A finger projects down from the trolley support wire near each street corner in such a way as to strike a trigger on the trolley arm of the car. The effect of this is to turn the indicator one notch, so as to display the name of the street which the car is approaching and to ring a bell to attract the attention of the passengers. As these fingers are at some distance from the street corners, passengers are warned in time to notify the conductor where they want to stop. It is said to be a decided improvement on the oral method of announcing the names of streets, as there is no danger of misunderstanding the name, and it eliminates the frequent opening of the car door in cold weather. As soon as the car reaches the end of the line the reversing of the trolley changes the mechanism of the indicator, and the signs are reeled off in reverse order.

ILLINOIS BRICK AND TILE MAKERS.

The programme for the Illinois Brick and Tile Association, which convenes at Springfield, January 17 and 18, includes the following:

Annual address by the president, C. F. Tenney, Bement, Ill.; a paper on "Hard Roads," by Joseph Stafford, Springfield, Ill.; "What has been Learned in Twelve Months about Brick or Tilemaking," by volunteers; "Report of the World's Fair Committee," paper read before the Illinois Commission; "Terra Cotta," a paper by William Gates, Terra Cotta, Ill.; Banquet at night at the Palace Hotel; Claywork-ing from Different Standpoints: "As a Tilemaker," by E. M. Pike, Chenoa, Ill.; "As a Brickmaker," by Anthony Ittner, St. Louis, Mo.; "As a Clay Journalist," by J. J. W. Billingsley, Indianapolis, Ind.; "Prices and Profits," a paper by George Gillen, Cantrall, Ill.; "Practical Road Drainage, by J. J. W. Billingsley; a paper, "The Manufacture of Brick and Tile," by Thos. E. Bonfield, St. Anne, Ill.; "A Poem," by D. O. Loy, Ashkum, Ill.

AN ELECTRIC EXCAVATOR.

There is in use at the works of the Purington-Kimball Paving Brick Company, near Chicago, an electric excavator. It is used for excavating clay in the clay pits, for which a steam shovel was used until recently. Electricity was substituted for steam by disconnecting the steam-engine and substituting for it a 50-H. P. Thomson-Houston motor, which is supplied with current from a generating station several hundred feet away. Feeding wires are run from the generating station to the edge of the bank, where they are connected to a pair of trolley wires arranged so that they can be moved from time to time as the shovel advances. The motor is suspended under the car on rubber cushions and is geared to a countershaft, which is in turn geared to the hoisting drum by a friction clutch. The countershaft is also connected with the mechanism for operating the boom.

LEGAL DECISIONS.

Dedication and Subsequent Diversion of Street for Railway Purposes.—In an action by a city to restrain a company from laying a railway track in a street, the trial court found that the original owner, in laying out the street on a "map, selling lots, and allowing the same to be used, expressed an equivocal and qualified intent to permit such user as a public highway, subject to the right of revocation;" and that, in permitting defendant to lay certain tracks and to build a freight house in the street, such owner had expressed an intent to revoke such qualified dedication before it was accepted by plaintiff, or by user by the public. At the request of plaintiff, the court found "that there has been a continuous user of the part of the public of the" street "since in or before the year 1845, except as the same was temporarily deflected by the laying of said railway tracks and the erection of said freight house; that from 1845 down to the time of the commencement of the action (1885), the public user of the street has been general, continuous and exclusive for all the purposes of a public street. . . . and that before the construction of the railway track, and the dedication of the street to the public had been accepted by the public by user." At the request of the defendant, the court found "that there never has been any dedication of the street for highway purposes" and "that there never has existed a public highway" at the place alleged by plaintiff. Under the circumstances the city was entitled to the finding most favorable to it; and as there was dedication of the land as a street by the original owner, and an acceptance by the public, it was entitled to the relief sought, against the railway company, which was a subsequent grantee. City of Cohoes *v.* Delaware & H. Canal Company, Ct. of Appeals of N. Y., 31 N. E. Rep. 887.

Macadamizing as Paving.—"Macadamizing," as shown by the employment of the word in the Pennsylvania statutes of 1887 and 1889, where it is used with "paving" connected by "and" or "or," to designate the general character of street improvements, is a species of paving, within the rule that, where streets have been once paved, they can not be repaved at the expense of abutting owners. City of Harrisburg *v.* Segelbaum, Supr. Ct. of Penn., 24 At. Rep. 1,070.

Excavating Beyond City Limits.—The acts of the city authorities in cutting or causing to be cut a deep ditch or excavation near, in, and upon the side of a lot outside the limits of the city, thereby causing a person's land and fence to fall and cave into said ditch or excavation, to his damage, are *ultra vires*, they having, at the time the acts were done, no power or jurisdiction over the land in question. Consequently the municipal corporation is not liable for damages resulting from such acts. Lord *v.* Mayor, Supr. Ct. of Georgia, 15 S. E. Rep. 818.

Duty of Borough in Laying Water Pipe.—It is the duty of a borough in laying a water pipe along a traveled highway to construct it in a safe manner, and to exercise due diligence to keep it in such a condition as not to endanger the safety of people lawfully passing. Baker *v.* Borough of North East, Supr. Ct. of Penna., 24 At. Rep. 1,079.

Legal Limitations to Rivalry in Business.—While fair and open competition is entirely proper and of public benefit, it is not permitted to a tradesman or manufacturer to appropriate the labels, brands and names adopted by his rivals, nor to announce to the trade his ability and readiness to supply the latter's customers with the very article, under the same name and label, for which the energy and means of the owner of the trade-mark have made a market. Neither is it permitted that he should so closely simulate the brands and labels of his neighbor that the public should be misled into purchasing his goods in the belief that they are the product or manufacture of those who introduced and gave them reputation. And it is not an equitable defense to an action to restrain the infringement of a trade-mark, that the goods or wares of the person accused of infringing the trade-mark are equal in quality to those of the owner of the trade-mark. In fact, a more permanent injury is inflicted upon the tradesman whose goods are supplanted in the esteem of his customers by those of equal quality, offered under his trade-mark, and at lower prices, since the competition of an inferior article is likely to be ephemeral. Cleveland Stone Co. *v.* Wallace, U. S. Circuit Court, Michigan, 52 Fed. Rep. 431.

No Rights are Waived by Paying Freight Overcharges Without Protest.—The payment to a railroad company of an overcharge in freight on goods transported over the road of such company is not a voluntary payment, as the law interprets that term, so as to bring it within the operation of the familiar rule which forbids recovery on account of payments voluntarily made withobjection or protest. The law does not here require objection or protest to the payment of unjust charges, for the reason that they would be vain, being addressed to those who occupy the commanding position of power to enforce obedience to their requirements, and because those who do business with railroads never come in contact with the officers who possess authority to fix or abate rates or charges; indeed, they usually hardly know their names or where to find them. Louisville, E. V. St. L. Consolidated R. Co. *v.* Wilson, Supreme Court of Indiana, 3 N. E. Rep. 311.

Liability for Defect in Machinery Unlikely to Do Injury.—There is no negligence in the construction of machinery which, when properly used in the ordinary manner, is safe under all conditions which will probably arise in any and every instance of such use. Hence, although it may have a defect, yet, if that defect be one which does not interfere with its safe and proper use, with reference to the purpose for which it was constructed, an injury to an employe while accidentally in contact with the defective part of the machinery, but which was very unlikely to occur, can not be attributed to negligence on the part of the company owning and operating the machinery so as to render it liable for the injury. Richmond & D. R. Co. *v.* Dickey, Supreme Court of Georgia, 16 S. E. Rep. 212.

Mortgaging Machinery or Goods After Making One Payment on Them.—Where the purchaser of machinery or goods, after paying the first installment on delivery according to contract, which contract was only a mere order for goods, accepted without reservation of title, executes a mortgage thereon for a new consideration or an old debt, which mortgage is duly filed, the title passes on delivery, and the mortgagee's title is good as against the seller, and this would not be changed, even though after executing such mortgage the purchaser gave the seller, as security for the rest of the price, his promissory notes, each with an express condition that title should not pass until payment in full had been made. Van Winkle *v.* Crowell, U. S. Supreme Court, 13 Sup. Ct. Rep. 18.

Cities Can not Destroy Wooden Buildings Without Process of Law.—It is not a part of the functions of a city government to enforce the terms of an agreement by forcible measures without process of law. So where a wooden building is maintained in defiance of a city ordinance and in derogation of the terms of the permit granted by the city for its erection, the city government has no power to enforce the terms of the permit by destroying the building without process of law, and a restraining order will be granted the owner until the final hearing and determination of the cause. Northern Pac. R. Co. *v.* City of Spokane. U. S. Circuit Court, Washington, 52 Fed. Rep. 428.

Countermand of Orders is no Excuse for not Paying Commissions.—Where a person agrees to pay a specified percentage on such orders as another shall procure, payable when such orders shall be obtained, the latter is entitled to such agreed compensation, even though some of such orders may afterwards be countermanded by the persons giving them. If, however, the orders are countermanded by reason of any default of the person taking them, that can be shown to defeat his recovery. Dorgan *v.* Turner, Supreme Court of Minnesota, 53 N. W. Rep. 650.

Relative Rights of Foreigners and Citizens to Use Trade-Marks.—A foreigner engaged in manufacturing and selling anything in his own country, under a registered trade-mark, has no common law right to such trade-mark in the United States, such as will enable him to claim the same on establishing a branch business here, as against a domestic firm which had an established business under a similar trade-mark, adopted in good faith, before he had sold any goods in this country. Richter *v.* Anchor Remedy Co., U. S. Circuit Court, 52 Fed. Rep. 456.

Sale of Goods by Sample.—A sale of goods by sample only binds the vendor to supply goods equal to sample, and not goods fit for a particular purpose. And where the purchaser is sued for the price of goods sold by sample, and alleges failure of consideration, in that the goods supplied are inferior to the sample, he is entitled to relief only to the extent of such failure and the amount of inferior goods which he proves. Kauffman Milling Co. *v.* Stuckey, Supreme Court of South Carolina, 16 S. E. Rep. 193.

Shipping Ahead of Time Does Not Pass Title.—Upon an order for a specified quantity of goods to be shipped to the purchaser on a specified day, the separation of the quantity from the seller's general stock, and shipping it before the specified day, is not an appropriation of the quantity separated to the contract, so that the title passes. It is a condition of the seller's authority to make the appropriation that he shall ship as directed. Hoover *v.* Maher, Supreme Court of Minnesota, 53 N. W. Rep. 646.

Papers Executed in Duplicate Are to be Treated as One.—Where two papers are executed in duplicate, one of the parties signing one of the papers and the other party signing the other, both papers together are to be treated as one document. Richmond & D. R. Co. *v.* Shoma, Supreme Court of Georgia, 16 S. E. Rep. 220.

A STATE ROAD CONVENTION IN MARYLAND.

The Deer Creek Farmers' Club, of Harvord county, Maryland, being assured of influential co-operation, has issued a call for a state road convention, to be held on Wednesday, January 15, in the hall of the Young Men's Christian Association building, Baltimore. The chief object of the convention is to organize a State Road League, with branches in every county, for the purpose of increasing the interest already awakened in Maryland in behalf of good roads.

COST OF FIRE BRICK PAVING.

The cost of laying 13,224 square yards of fire brick paving in Wilmington, Del., during the fiscal year 1891-2, as given in the last annual report of the street and sewer department, was $2.10 per square yard. Most of the paving was on stone foundation and most of it was tarred. Some of the paving which was not tarred was grouted. On the different streets the per centage of loss of bricks per square yard varied from 1 9-10 to 4½ per cent. Nearly all the brick used averaged about $18.50 per thousand in cost, but some were bought for $14, all delivered at Wilmington.

PERSONALS.

Mr. Drexilius is now at the head of the water-works of Buffalo, N. Y.

Mr. J. W. Kendrick has been elected city engineer of Birmingham, Ala.

Mr. Jno. H. Dockweiler has been re-elected city engineer of Los Angeles, Cal.

J. C. Stearns has resigned as superintendent of the city water-works of Charles City, Iowa.

Mr. Geo. E. Mann, for many years city engineer of Buffalo, N. Y., is succeeded by Mr. S. J. Fields.

Mr. Albert Smith, of Saltsburg, Pa., has in charge the main sewer construction of Corry, Pa., which has been resumed after a six months' delay on account of a defective city charter.

At the meeting December 7 of the American Society of Civil Engineers, the following candidates were elected: Members—Wm. H. Brown, Philadelphia, Pa.; Howard Constable, New York City; Edmund J. Spilsbury, Trenton, N. J. Associate Members—Henry F. Baldwin, Chicago, Ill.; Edward F. McConnell, Indianapolis, Ind.

The following are the officers for 1893 of the Engineers Club of St. Louis, as elected December 7: President, Robert Moore; vice-president, B. L. Crosby; secretary, Arthur Thacher; treasurer, Charles W. Melcher; librarian, R. E. McMath; directors, J. B. Johnson and Geo. H. Pegram; members of board of managers, J. B. Johnson and J. A. Baird.

A NEW KIND OF PAVING BRICK.

The Toronto Chemical Smelting Company, of Port Colborne, Ontario, Can., is about to manufacture hard, black glass building and paving brick. The material is obtained as a result of the use of a new patent process of reducing and refining nickel from the ores, and would, unless utilized in this manner, be an absolute waste. It is claimed for these brick that they will be extremely hard and durable, and especially adapted for paving purposes. One of the streets in Port Colborne will shortly be paved with them.

TO PROTECT STREET PAVEMENTS.

Upon the recommendation of Capt. Fiebeger the following article will be added to the police regulations of Washington, D. C.:

"That no person shall deposit on any asphalt or concrete pavement any building material, unless the pavement is covered with a close fitting platform of boards."

LETTERS FROM THE PUBLIC.

THE NOMENCLATURE OF ASPHALT PRODUCTS.

To the Editor of Paving and Municipal Engineering:

Sir—I have carefully read, in your valuable magazine of October last, an article entitled "The Nomenclature of Asphalt and Bituminous Products," by Leon Malo, Consulting Engineer, Pysimont, Seyssel, France, translated by W. H. Delano, Paris.

Mr. Leon Malo seems to be quite surprised that his nomenclature of asphalt and bituminous products proposed by him since about thirty years ago is not adopted.

The proposition of Mr. Malo is to call *asphalt* all natural products of carbonate of lime with bitumen, while the proper adopted term is *bituminous limestone* or *bituminous carbonate of lime.*

I am ready to prove that his proposition is devoid of logic, clearness and scientific principles, and that his proposed classification would create an embarrassing confusion. Thus it is no wonder that the scientific world adheres to the clear and comprehensive language as found in all good dictionaries, encyclopedias and adopted all over the world by our great standard authorities.

Now let us see if Mr. Malo's proposition is logical and has for a guide the principle of science.

As the science of chemistry progressed its nomenclature was changed accordingly. These changes had always for principle clearness for the adoption of its terms by which the composition of a compound is expressed. For instance, by the term *carbonate of lime* ($Cao\ Co^2$) we learn that the mentioned compound is composed of lime and carbonic acid ($Cao+Co^2$).

By using the wording *bituminous limestone* or better, *bituminous carbonate of lime,* it is perfectly understood that this natural or artificial mixture is composed of *carbonate of lime* (*limestone*) *and bitumen.* Now if Mr. Malo's proposition was adopted, by calling the above mixture *asphalt,* the result would be a confusion of language. Since, when consulting our best dictionaries, encyclopedias, etc., we learn that the name "asphalt" is not only known since about 40 years ago, but is applied since ages to certain natural hydrocarbons with which carbonate of lime has no relation. It is true Mr. Malo makes a statement by saying, "When bitumen impregnates limestone, naturally the product is asphalt." This theory not only is devoid of science, but it is ridiculous, at least to those who possess some knowledge of chemistry. It seems that Mr. Malo has been guided by some unknown and unexplained erroneous idea, to bring forth such an illogical term as asphalt for bituminous limestone.

Mr. Malo ought to know that when bitumen impregnates carbonate of lime the carbonate of lime and bitumen remain unchanged, no chemical reaction takes place between the two compounds, and consequently the statement of Mr. Malo lacks reason and is not true.

The conclusion we reach is that to call bituminous limestone asphalt would distort the term asphalt from its primitive and true meaning.

Mr. Delano appears to dislike the terms of asphaltum and asphaltic cement. This being a question between Mr. Delano and all dictionaries, I have nothing to say. His proposition ought to be addressed to the authors of these useful books.

E. J. DeSmedt, Chemist.

New York, December 14, 1892.

To the Editor of Paving and Municipal Engineering:

Sir—Your correspondent who writes upon the classification of asphalt in your issue of November, can call Trinidad pitch, composed of 33 per cent. water, 33 per cent. fire clay (which can not be eliminated, being of the same density as the pitch), and 33 per cent. pure pitch—asphalt—but that does not alter the fact that asphalt is bituminous limestone. His knowledge of this special question is recent—too recent and complete.

Here, there are people who call gas tar, shale grease and petroleum, still bottoms, asphalt, with just as much reason.

I have never seen your correspondent, Mr. Gibson, so I never got him to do anything; he can no doubt defend himself.

When in New York last July, I asked the authorities to be allowed to bid for natural asphalt roadways, as the Trinidad pitch compound laid in Paris under Mr. Schubert's superintendence had broken to pieces. I was told I could bid, but it would be difficult to send orders to Paris. That is why my company has bought land and put up machinery at Hunter's Point, Long Island City. The steam engine, boiler and ordinary plant are of American manufacture, and next year we hope to start an American company with an American Board of Trustees, and an American manager, and show better work than has ever been done before.

The town of Berlin has nearly 1,000,000 square yards of compressed asphalt; London, 600,000; Paris, about 500,000.

We shall exhibit class 12, mining produce, in French section at Chicago exhibition, and I am preparing a little book giving my experience with natural asphalt for over twenty years, which may perhaps clear up some misconceptions, and Mr. Malo has painted a 15 foot high oil picture, to show what the Seyssel asphalt mines are like inside. We shall show models of all that can be done in asphalt and mineral bitumen.

Paris, Dec. 9, 1892. *W. H. Delano.*

FOUNDATION AND CONSTRUCTION OF BRICK PAVEMENTS.

To the Editor of Paving and Municipal Engineering:

SIR—Having read with much interest the able reply to a citizen of Knoxville, Tenn., by Mr. Charles P. Chase, of Clinton, Iowa, to an inquiry as to the merits of brick pavements, published in the December number of your magazine, I wish to particularly commend one or two points made by Mr. Chase:

First—As to foundations. Experience in this city confirms the fact noted by Mr. Chase, that a pavement "*satisfactory in every respect*" can be made without either the costly concrete foundation or the double course of brick so generally adopted for brick pavements. We have our street paved with a single course of brick, as described by Mr. Chase, except that well-rolled gravel was used in place of broken stone.

At the time the improvement was in progress public sentiment very generally condemned the judgment of the engineer in admitting this foundation in the specifications. After over a year's traffic this street has a much better surface than that of an adjoining street, which was paved with two courses of brick and at a cost greater by 30 per cent. than the single course. I have recently compared the surface of this single-course pavement on gravel foundation with brick pavements in other cities and believe it is at least as good as, if not *better* than, those on concrete foundations. To-day public sentiment in this city is as pronounced in favor of this foundation as it was in opposition to it when it was first proposed.

I do not wish to advocate a cheap foundation simply because it is *cheap*, but if the cheaper foundation is as good as, or better than, the more costly, it is important that this fact be more generally known.

Second—This city is the only place, so far as I have been able to learn, where the courses in brick pavements are *not* laid at right angles with the street. The top courses on *all* brick pavements in this city are laid at an angle of forty-five degrees with the course of the street. This was done for the reason that I had noticed that plank on bridges laid in that manner wore longer and made a smoother surface, with less jar to passing vehicles, than when the plank were at right angles with the bridge, and it seemed reasonable that the same would hold good in relation to the courses of brick pavement. It has been a matter of surprise to me that others have not adopted the forty-five-degree angle in brick pavements, and have thought perhaps there was some reason for adhering to the right-angled courses that I was not aware of. It was, therefore, a source of no little satisfaction to note the recommendation of Mr. Chase that *all* brick pavements be laid at an angle of forty-five degrees, and the statement that at street intersections, where they were so laid, the pavements were wearing better than where laid at right angles.

The point made by Mr. Chase that it is not essential that a brick should reach the point of fusion (be vitrified) in order to make a good paver, is also well taken, as is shown by experience in this city, unless that point is reached sooner than is generally supposed. I noticed that brick that have not taken the color usually supposed to indicate vitrification become very near impervious, and are tough and appear to stand as well as those that are unquestionably vitrified. But of course clays may differ in this respect.

William M. Whitten.

South Bend, Ind., Dec. 17, 1892.

THE IMPORTANCE OF WIDE WHEEL TIRES.

To the Editor of Paving and Municipal Engineering:

SIR—In your issue for November Mr. Macklind, in his article on "Street Paving in St. Louis," reports, with seeming approbation, the extensive use of granite pavements "for manufacturing and mercantile traffic." He says of asphalt: "While it has been subjected to the heaviest loads hauled in the city with fair results, it must stand below granite for wear."

The cost of traffic over almost any street or road surface—that is, the cost of wearing out such surface—is greater than the cost of keeping up the surface under traffic. However little granite is worn by traffic, the cost of this wear to owners of horses and vehicles or to the community at large is many times greater than the cost of wearing asphalt or brick even as much faster as they are said to wear.

Mr. Macklind speaks of brick pavements failing "under the conditions of traffic," meaning its use by "commercial teams." Why not change the conditions, which are all wrong. Commercial teams really mean the hauling of *still heavier loads* on wheels (tires) already much too narrow for light traffic vehicles.

I quote again: "It being a self-evident proposition that the drier the roadway the longer the life and the more efficient the service, at the lowest cost of maintenance it remains to provide for the elimination of dust and mud from the problem of good streets. The first step in this direction is perfect cleaning."

It is much more important to know and say that the greater the tire width the longer the life of the roadway, whether dry or wet, the less its cost and the less the greater cost of wearing out the surface; that is, the cost of traffic over the surface. What we most need is to know how to reach the lowest cost of maintenance, which is in effect the first and by far the longest step in the direction of cleaning, since it obviates the necessity for most of the cleaning now required. Manifestly broader wheels tend to prevent dust and mud and their attendant cost, tend consequently and correspondingly to prevent traction or cost of hauling, besides tending to lessen both first cost and maintenance, cost of pavements and road surfaces. Even "heavy traffic" should be facilitated, and just as much so as light traffic.

It is pretty generally admitted that asphalt facilitates both light and heavy traffic most *while it lasts*. Now, the fact is that asphalt pavements can be perpetually maintained for and at the capitalized first cost of granite pavements in St. Louis and Memphis and most other places.

With adequate tire widths no doubt enough money could be saved in cost of wearing or using streets and roads to pay for keeping up the street and road surfaces (including all expenses) of whatever material they may be made. Now, since "heavy traffic" (meaning always destructive traffic) is simply the very expensive bad practice of using narrow tires, why should we not stop the practice and do away with even the alleged necessity for granite pavements?

Granite makes traffic from three to ten times as "heavy" as it is on asphalt, and the present narrow tires make traffic very much "heavier" on any pavement or none than it needs to be.

J. M. Heiskell, M. E.

Memphis, Tenn., Nov. 21, 1892.

SELECTIONS FROM THE PRESS.

BRITISH AND AMERICAN BRIDGE BUILDERS.

The larger bridges on the Transandine Railway are of American construction. The reason for this is certainly interesting, as it raises an important point on the relative value of American and British bridge building practice, and shows how that practice operates in the matter of securing foreign orders, or orders for foreign countries, which is not quite the same. Time was an important element in the matter; the railway was practically completed, but could not be opened until the bridges were constructed and in position.

Several British bridge-builders were therefore asked to state the time they would require to build a bridge of 246-foot span, and the shortest time was eight months. A cablegram to American firms brought the reply from two that they would deliver all the four bridges of the size required alongside a vessel at New York in eight weeks, while a third asked twelve weeks. There was no alternative. Cables were again sent to the three firms stating the load and the tests to be made when the bridge was in position, and offers were at once sent. The span we have given; the tensile strength of the steel used was to be from 26 to 30 English tons (58,240 pounds to 67,200 pounds) per square inch, with an elongation of 20 per cent. in 8 inches before fracture. The builders were to guarantee that the bridges satisfied the test requirements when in position. The main girders were to be 15 feet 1 inch, c. to c., to carry the single line of meter gage (3 feet 3⅜ inches). Here are the offers:

Tenders for Bridge of One Span, 246 feet.

Name.	Price £.	Weight, tons.	Per ton £.	s.	d.	Cents per lb.	Deliv. wks.
Union Bridge Co.	2,515	156	16	2	0	3.85	12
Phœnix "	2,687	156	16	17	8	4.01	8
Edge Moor "	2,493	164	15	8	5	3.29	8

Time, as we have said, was the consideration, and weight was an important element in view of the distance the bridge had to be conveyed inland, so that the Phœnix Company got the order, although their price was highest. It is interesting to note that the changing of the material from iron to steel only involved an increase of 5 per cent., the tests being as above, and it is further noteworthy that the Phœnix Company wished the truss to be 35 feet deep, and offered to make the price less with it than with a 32-foot truss.

The point suggests itself: How could the American firms offer to build the bridge in as few weeks as the English firm required months? The reply is simply that their system of bridge-building enabled it to be done. Here the builder gets his drawings from the railway engineer, who designs every rivet and bolt, if he does not specify how the rivet or bolt is to be driven. A. B. wishes one style, C. D. an entirely different type, so that the builder must be prepared for anything—the advocates of the American system might say for nothing. In America, on the other hand, the builder designs the bridge, or rather, he has a standard type, and the engineer only needs to state requirements. The firm can therefore have special machinery for rolling their iron or steel to the standard sections needed and are thus independent of steel makers. They are, therefore, prepared in the fullest sense of the word. It may be urged that the British system admits of greater choice of design and therefore suits British needs; but after all it is to the foreigner we, in large measure, have to look for orders, and, as a rule, he is satisfied with what he can get quickly and cheaply, provided it meets the desired conditions as to load and tension and compression tests. We do not enter into the relative value of American and English designs, or as to whether American or British prices are lowest. Our contention is that there are most convincing evidences that the American practice has its advantages. As to relative prices, it is to be regretted that in the case of the 246-ft. span quotations were not got from

English as well as American firms; but Messrs. Clark's business was not to collect proofs on economic points. Fortunately, however, the idea suggested itself, presumably for other reasons, to get an English firm to quote a price for a 197-ft. span from sketch drawings supplied by an American firm who had tendered, so that we have in this case comparative prices:

Quotations for 197-ft. Span.

	Price.			Weight.	Price. per ton.			Price. per lb.
	£.	s.	d.	tons.	£.	s.	d.	cts.
Pencoyd B'dge Co.	1,679	13	0	117¾	14	5	0	3.09
British firm........	2,025	3	0	138	14	13	6	3.18

It will be noticed that the British firm (which need not be named) assumed a greater weight—that is, in accordance with practice—and that their price per ton was greater, notwithstanding that material and wages are said to be dearer in the States. Of course, the American firms have special machinery. This, however, one may find in almost all concerns.—*Engineering, London.*

HOW TO TEAR UP A STREET.

One of the most marked things in European cities to the American traveler is the frequent evidences of the employment of highly skilled labor upon work which would be done by unskilled labor in this country. A city official of New York said a short time ago it would be impossible to keep the streets of New York in a state of cleanliness and repair similar to the boulevards of Paris because of the expense, which the tax-payers would not stand. And he went on to say that, granting the tax-payers were willing to stand the expense, the needed number of skilled laborers could not be found. But in Paris such things can be done quickly and skillfully, because a large force, an indefinitely large force, of highly-skilled laborers may be hired for a small sum. The result is that even the humblest work is done with an exercise of skill and intelligence which amazes an American. When a street or building is to be repaired a great force of trained laborers is gathered, the materials for labor come with them, and the work goes forward swiftly, quietly, in an orderly manner, with so little muss and fuss that passers-by are hardly conscious that anything is doing.

An American drinking a small bottle at a little table in front of the Cafe de la Paix one day last summer saw an illustration of this. As he discovered later on, a gas-pipe four or five feet below the level of the asphalt, not far from the curbing, was in need of repair. Toward 10 o'clock a man with a spade, a hammer and a chisel appeared with an assistant, who carried two great baskets. The two laid down their tools, and one of them took from one of the baskets a rope and a number of iron standards, sharp at the lower ends. Quickly the men drove these standards into the asphalt and stretched the rope around them so that a square space eight feet by four was inclosed. The assistant took from the basket a big placard and leaned it against one of the standards and went away. The placard was an announcement that the laborers had permission to take up the asphalt and repair a gas-pipe.

The other laborer climbed over the rope and marked out upon the asphalt a square six feet by two and a half. Following this mark he chiseled through the asphalt, and when he had separated the piece inside the mark he carefully lifted it out and laid it to one side. Then he took his spade and dug up the gravel and other stuff that formed the immediate foundation of the asphalt. This material he put into one of the baskets. Then he attacked the earth underneath, and soon had his hole dug to the required depth, with the gas-pipe exposed. All the dirt he had taken from the hole was in the other basket. If there had been a fine carpet up to the edge of the hole on all sides it would have been only slightly sprinkled with soil and not at all injured.

When he had done he gathered up his tools and looked impatiently up the street. His face cleared at once and broke into a smile of greeting as two laborers, armed with tools and a basket, appeared. He left them and went away. They were evidently plumbers and understood their business, for in almost no time at all the pipe was fixed and the plumbers were standing outside the rope looking about them. They did not have long to wait. The laborer who had dug the hole reappeared and they went away. He proceeded with the greatest care, but very swiftly, to put back the earth and to ram it down with a rammer he had brought with him.

Just about the time he began to put back the gravel a roller and engine appeared. Another laborer climbed over the rope and helped him with this last work in which hot tar was used. They laid back the piece of asphalt which had been cut out and laid aside, and filled in the crack. Then they pulled up the stakes and threw them into one basket and the placard into the other, the roller passed over the place two or three times and then they all went away, leaving no dirt, no muss, and only a square line of a slightly different color from the rest of the asphalt to show that anything had been done. The American who was watching all this looked at his watch. It was not quite 12 o'clock. The work had been done in about two hours. The street had not been blockaded. No great and unsightly piles of dirt had been thrown up, the blouses of the laborers were as clean when they went away as when they came. The street was as perfect as if it had not been disturbed.—*New York Sun.*

ELEVATED SIDEWALKS.

Considerable interest has been shown in many quarters at the suggestion already started of a system of elevated sidewalks in Boston. It was pointed out at the time that the scheme offered an apparent solution of several of the most perplexing problems in street traffic. Another point that was not touched upon was the fact that the under side of the elevated walks could be utilized for the stringing of wires.

John A. Seaverns, an electrical and mechanical engineer, says that the whole plan, as outlined by its originator, S. D. Hannah, of the real estate firm of S. D. Hannah & Co., is worthy of close consideration, and that the solution of the wire problem which it offers is the best that has yet been suggested. He thinks that with such a system of sidewalks the entire wire system, now run either overhead or underground, could be strung in cables of from one to two hundred wires along the under side of the elevated walks, with distribution boxes at the corners of the streets, whence all wires could be carried into the different buildings without being exposed, and also without necessitating the stringing of long wires from distant points, as is now so often the case. A single company could be formed for the purpose of stringing the cables and keeping them in thorough order, and then any company or individual needing wires could rent as many as might be required at a price which would be much less than the present cost to all the different companies that have their own systems and undergo great expense in keeping them in repair.

The city could charge a rental for the use of the under side of the walks for stringing the cables, and the revenue thus derived would go a great way toward paying the interest on the entire cost of the undertaking. Such a wire system could be nearly perfect, as storms could not affect the cables, and there would be no loose, dangling wires to interfere with traffic and perhaps endanger the lives of passers. Added to these advantages would be the clearing away of the network of wires which now obstructs the streets overhead, and so mars the prospect, and the removal of the constantly multiplying number of posts and poles that line the edges of the surface sidewalks.

With regard to the system of pipes by which the elevated walks could be kept clear of snow, it is suggested that the steam connections could be made in sections, just as is now done on the roofs of many buildings. Alternate sections of about four feet in width could be supplied with pipes and filled in with fire-clay, the sections in between being made of perforated iron plates with glass bull's eyes running down about three inches and having the lower end cut at an angle, so as to multiply the light entering through them as much as possible. No extra expense would be incurred in supplying steam for such a system, as one can readily see by looking out from one of the higher windows in one of the new tall office buildings and noticing how numerous are the waste pipes about the city from which the "exhaust" steam is escaping all the time.

Another advantage which the elevated sidewalks have over the arcade plan is that open spaces can be left at regular intervals between the walls of the buildings and the walks, thus allowing considerable additional light to enter the store windows below. The stay wires of the electric car system could also be attached to the supports of the elevated walks and thus the poles now needed could be removed. Not the least of the advantages to be gained by such an elevated walk system would be the perfect freedom to walk straight on to your destination without having to stop at every crossing to let cars and carriages and trucks go by.—*Boston Transcript.*

LOUISVILLE'S DEMAND FOR GOOD STREET PAVEMENTS.

Modern ingenuity will yet devise some durable, noiseless and economical pavement. Millions are annually spent in American cities with results that at present are far from satisfactory. Granite, well laid, is durable, but is intolerable on account of the noise. One remedy would be rubber tires, and the world is coming to rubber tires.

In London it is no uncommon thing to see the best cabs with rubber tires. The record of Nancy Hanks will give a new impetus to this change, and though the wagons for heavy traffic may see no benefit in them, all pleasure and passenger traffic will in time be carried on rubber tires. In this way you carry your asphalt around with you.

The asphalt pavement is smooth and noiseless. On the other hand it is dusty, expensive and not durable. It requires constant repairs, and repairs are rarely satisfactory. We speak only of asphalt in Louisville. That it might be made more satisfactory we believe; that here it is very far from satisfactory is not to be denied.

Asphalt blocks, or blocks of some composite character, would have evident advantages over the ordinary asphalt, if they could be made at a reasonable figure.

Vitrified brick is a new material for street pavements. If made with proper care, and if inferior material be rejected, brick will, we believe, be an excellent substitute for macadam, and the indications are that brick will, in this climate, meet with the requirements better than asphalt. Time alone can determine this. Success depends first on the use only of the best quality of brick, and second on the manner in which the brick is laid. A good foundation is essential to a good pavement of any material.

Wooden blocks were discarded some years ago as unsuitable, but experience and observation seem to show that the fault was not so much with the wood as with the foundation on which it was laid.

Wood blocks will not do for very heavy traffic, perhaps, but no pavement for ordinary traffic is more delightful than wood. But here we put wood down on a foundation of sand or clay, covered with a thin pine board. It might be well to try wood on a concrete foundation, such as we prepare for granite and for asphalt; such as we should prepare for every pavement. Let the foundation be laid once for all; it will then suit any covering.—*Louisville Courier-Journal.*

THE GENERAL DEMAND FOR VITRIFIED BRICK.

The rapid growth of brick pavements throughout the country is but another evidence that the people are awaking to the fact that vitrified brick is the proper material to be used in roadway paving. It provides a smooth and durable wagon track that is not likely to get out of repair and can very easily be kept clean. In all of the cities and towns where brick pavements have been put down they have given the most complete satisfaction. This is particularly so in the West and Northwest, and in the larger cities where the traffic has been unusually heavy the pavement shows no evidence of the wear and tear of heavy teaming. In the city of Davenport, Ia., the council recently passed a resolution to pave twenty-four of the principal streets with vitrified brick, and the work will be started in the spring. They will use a broken stone foundation with one layer of brick upon streets where the traffic is light, but upon business streets the same foundations will be used with a double course of brick. Des Moines, Ia., has entered into a contract to pave every street in the city with brick, made right on the spot. All over the country the desire for this class of paving is on the increase, the latest converts coming from the South, as the cities of Baltimore, Md., and Roanoke and Alexandria, Va., have decided to use it. Chicago is already in line, and it has been demonstrated to the city authorities that brick is proving to be the best paving material. The granite blocks used on our principal streets do not give satisfaction. They may be durable, but are generally rough, noisy and difficult to keep clean. Brick, therefore, is the proper solution. That this is the state of the case is evidenced by the large number of paving brick plants which are being put up all over the country. The demand for this character of pavement is so great that the capacities of the various vitrified brick plants have been tested to the utmost and in a number of cases they have been unable to fill their orders.—*Clay Record.*

MACHINERY AND TRADE.

BRICK DRYING.

As the history of brick machinery has been a record of constant improvement, likewise has that of its most important adjunct—the drier.

While a few years ago an artificial drier was considered a questionable investment, and at best an expensive luxury, it is not so regarded to-day; but, on the contrary it is an indispensible necessity, which no wide-awake, progressive concern can afford to be without.

Numerous processes have been tried in the past, with varied success; some have proved absolute failures, and have disappeared from the scene of action, while others have been found either too expensive for general use or too crude to fill the requirements of a successful and practical brick drier.

The limited success which has been met with thus far in the drying of clay products is attributed to a lack of study of heat radiation and other well-defined principles involved in the science of drying.

To dry brick and like material economically and rapidly, the air with which they are brought in contact must be heated to the maximum degree, that the nature of the clay will stand without injury.

When it is taken into consideration that an increase in temperature of twenty-five degrees renders the air capable of absorbing about double the quantity of moisture, it is evident that the greatest economy is attained when all the heat is applied that the nature of the clay will warrant. The idea that heat alone will dry is, however, an erroneous one, and has been the cause of many disappointments. Science proves that the principle office of heat in any drying process is simply to increase the capacity of the real medium, which is the common atmosphere.

Air, as a fixed or stationary body, will absorb moisture in proportion as it is expanded by heat. But it has a limit at which its drying power ceases. This is called the point of saturation.

It becomes necessary, then, to replace it with drier air. In doing this, nature's own methods should be followed. This involves no new and untried principles or complex theories; the only means required being such as shall create a circulation that is continuous and sufficiently rapid to prevent the air reaching the point of saturation. The nearer that point is reached the slower will be the process of absorption. This is the theory of drying faster on a windy day than on a calm one.

The most practical method of maintaining a positive circulation of the air is by mechanical means, involving the use of a fan of the blower type.

The factors in drying, then, are heat and air; the one to evaporate the moisture and the other to absorb it.

A perfect system of drying involves, however, something more than the mere application of the elements of drying to the green brick.

The impression has prevailed, it would seem, that all kinds of clay products should be treated alike, and for that reason no adequate provision has ever been made to change the conditions to suit the different varieties of clay. It is perhaps to this fact, more than to any other, that the artificial drier in the past has in so many cases proved a failure.

Another difficulty encountered in drying, by whatever method, has been the inability to control the hot air currents; that is, to maintain the same degree of heat at the top, center and bottom of drier.

The natural tendency of hot air being to rise, the temperature in most driers (both steam and furnace heat) is considerably higher in the upper part of the room than at the center and floor line, resulting in not only greatly retarding the drying process, but also injuring the quality of the product owing to the varying temperatures to which the material is subjected.

It is evident, in the light of past experiences, that the drier of the future, in order to fully meet the requirements of the various clay products now on the market, must, in the first place, be susceptible of perfect regulation. 2d. The heating arrangement must be such that the air can be heated to the maximum degree that the nature of the product to be dried will warrant, in order that the drying may be done rapidly and economically. 3d. Some positive means must be provided for maintaining a uniform circulation of the heated air, for the reason that if it becomes irregular it causes an uneven distribution of the heat, promotes unequal expansion and consequent cracking and retards the drying process. 4th. The air currents must be controlled so that all parts of the material are subject to a like degree of heat. 5th. The ventilation of the drier must be so governed that the moisture or water smoke can be gotten rid of at will, or retained as circumstances require.

A candidate for public favor filling these requirements, is the Standard Patent Forced Draft Drier, manufactured by the Standard Dry Kiln Co., Louisville, Ky. It has been particularly successful in drying paving brick.

A LEAD-LINED IRON WATER PIPE.

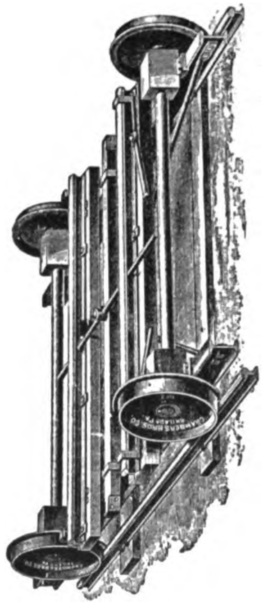
A lead-lined service pipe has been devised by Mr. George W. Harrington, Superintendent of the Wakefield (Mass.) Water Co., and is now being manufactured at Wakefield by the New England Water Pipe Co. This pipe is designed to give all the advantages of lead pipe without using the large amount of lead which is necessary for pipe under heavy pressure.

In manufacturing the pipe ordinary iron pipe is used. In this a thin lead pipe of smaller diameter is inserted and then expanded to fit the iron.

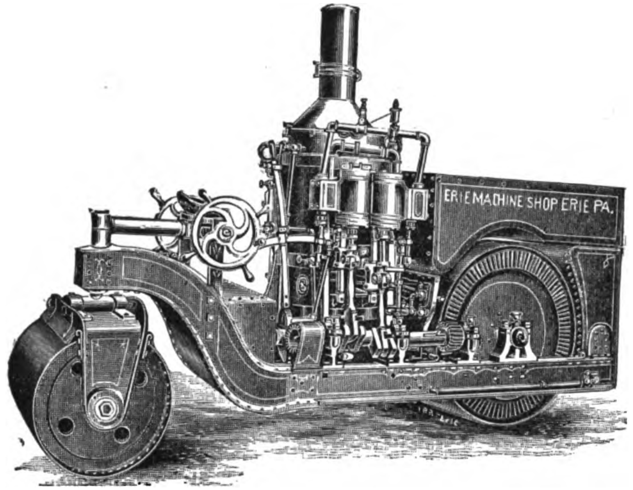
When a length of pipe is cut the exposed ends of iron are protected with lead. A tool is inserted in the end of the pipe to press the lead against the iron. A thimble is then inserted and driven home by the tool, which trims off all surplus lead and forms a lead bead at the end of the pipe. When a thread has been cut on this pipe and the pipe screwed into a fitting, the thread on the fitting screws against the beaded end of the thimble, so that no part of the pipe is exposed to the action of the water.

A NEW TRANSFER CAR FOR ARTIFICIAL BRICK DRIERS.

This transfer car is designed for hard usage, and to withstand the rough handling to which this adjunct of the modern brick-drier is subjected in large works where hundreds of car-loads of bricks are transported daily. The body of the car is made of wrought iron beams braced by heavy cross-rods. The axles are of two-inch iron, with turned journals running in a packed lubricated box. The wheels are keyed to ends of axles, and when worn can readily be renewed. The car has a substantial lock-bar, operating at either end of the car and moved by forged iron foot levers. All of the fittings of the car are forged, and there are no light castings to be broken by a kick from a heavy boot on a frosty morning. The manufacturers are Messrs. Chambers Bros. Co., Philadelphia.



THE ERIE STEAM ROLLER.


ERIE MACHINE SHOP ERIE PA.

The Erie Steam Road Roller is made as nearly as possible of wrought iron and steel. The main frame is made of ½ in. by 9 ft. steel channel beams, strongly braced with cross beams of the same material and shape, and well riveted together. The small front rollers are 30 in. diameter; two of these rollers are placed together on one axle, revolving independently of each other, making a continuous drum 39½ in. wide, and is of ½ in. steel plate. The large roller is 48 in. diameter, 39½ in. wide, and is made of ⅝ in. steel plate. The shaft of large roller extends through the entire length, and is 4 in. diameter. In case it is desired to load the roller heavier, the weight can be put on shaft on the inside of roller, thus having the weight on the bottom and not making the machine top heavy. There is also a universal joint at the front of the machine, in which the vertical pivot, corresponding to the king bolt in carriages, allows the front axle to assume any angle with the axle, thus doing away with all twisting strain on the frame.

There are two 6 in. by 6 in. high pressure reversible engines. The connecting rods and crank shaft are made of the best hammered iron. The segments on large roll and the driving pinion are made of steel. The front bearing in goose neck is made in two parts, in order that the bolt may be taken off without any trouble. A small tool box is placed in front of the machine for the convenience of the operator, where wrenches, waste, etc., can be kept.

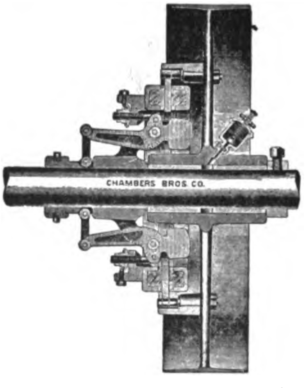
The steering gear is made of one steel screw with brass nut, is very quick and strong, thus dispensing with the expense of keeping in proper order a combination of gear wheels, chains, etc.

The boiler is vertical, made of steel, and is of the best workmanship. Handholes are freely provided for washing-out purposes. It is fed by either pump or injector, and is jacketed with asbestos and Russia iron. All bolts are double nutted, thus preventing loosening on the road.

The manufacturers have made some changes in the roller during the last year. The frame is longer and made of heavier iron. The large roller is heavier and also the goose neck. The head block is made in two pieces and some other changes have been made, all greatly improving it.

FLEXIBLE FRICTION CLUTCH.

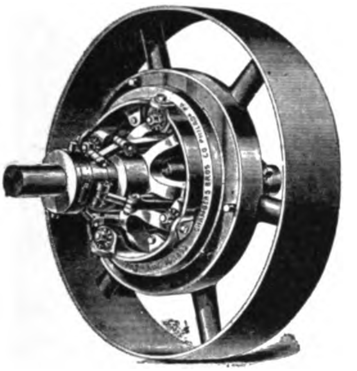
This new flexible friction clutch, as applied to driving pulleys, is illustrated in the following sectional view, and is believed to present several points of superiority over the various styles of friction clutch pulleys now on the market. Among the features peculiar to this clutch are the following:



First. A friction disc flexibly connected at its outer edge to another part of the device. This arrangement admits of the pulley running out of true without straining the clutch, and also admits of the inner clutch member being rigidly fastened to the shaft, the outer clutch member alone being movable. It also insures the pressure of both of said members being equal under all conditions.

Second. The inner clutch member being rigidly fastened to the shaft admits of the levers being fulcrumed to said member, and these levers are so connected to the outer clutch member as to render absolutely positive the releasing of the clutch. No springs of any kind are employed.

Third. Each lever being balanced on each side of its fulcrum, so that at the highest speed centrifugal force has no tendency to either cause or resist the movement of the levers.



Fourth. In comparison with clutches having four or six pairs of clutch members, all of which, to be efficient, must move in unison and bear with equal pressure on the opposite sides of a rigid cylinder. The "Waldron" has only two clutch members, but one of which moves, and thereby transmits its pressure against the disc to the opposite member. In the style of clutch under comparison, the load strain has a tortional effect on its clutch members, while on the "Waldron" the strain is in line with the resistance.

Fifth. All parts of the "Waldron" clutch being balanced, there appears to be no reasonable limit to the speed at which it may be run with safety.

Sixth. The "Waldron" clutch has but few parts, and having a very large gripping surface in proportion to its diameter, enables one to use in comparison with other clutches a smaller diameter of "Waldron" clutch for the transmission of a given horse-power. The "Waldron" thus not only weighs less than other styles, but the weight is close to the shaft, making a decided advantage in its favor on high speed work.

Seventh. It occupies the least amount of room on the shaft. The clutch is constructed in the best possible manner, the parts are interchangeable, and it has been tested under trying circumstances.

This clutch is made by the Chambers Brothers Company, of Philadelphia, and is being placed by them on their brick-making machinery.

NOTES.

The new catalogue of the Frey-Sheckler Co. is ready for distribution.

The Frey-Sheckler Co. has sold an Acme brick machine outfit to the Sioux Paving Brick Co., Sioux City, Ia., and a complete plant, comprising brick machine, crusher, pugmill, cutting tables, elevators, trucks, etc., to the Columbian Brick Co., Connellsville, Pa.

Attention is called to the new advertisement of The Decatur Leader Manufacturing Co., Decatur, Ill., who have placed on the market several new machines and appliances for the manufacture of brick. Cuts and detailed descriptions will shortly appear in these columns. Printed matter may be had by addressing them.

The Frey-Sheckler Co. have sold a steam power re-pressing machine to B. Kreischer & Sons, Perth Amboy, N. J. This is the second press sold these people in the last six months. They have also received an order from the Fort Smith Paving Brick and Fire Clay Co., of Fort Smith, Ark., for two of the steam power re-pressing machines.

J. W. Penfield & Son, of Willoughby, Ohio, have issued what they call "A Condensed Catalogue for Busy Brick-Makers," briefly enumerating their large variety of manufactured products. This is the eighth of their series of handsomely printed catalogues relating to their machinery and the interests connected with their business, any of which they will send on application.

The Frey-Sheckler Co. sold a No. 2 Bucyrus Giant brick machine outfit to H. N. Zapel & Bro., Chicago, Ill. This makes the twelfth outfit of machinery they have shipped to Chicago since January, 1892. They sold a Mascot machine, with hollow block outfit, to A. J. Haws & Sons, Johnstown, Pa. This is the second outfit sold to these people in the past year.

On a trip to Cincinnati recently a representative of Paving and Municipal Engineering was shown some specimens of paving brick which were extremely hard, dense and heavy, and upon breaking one of these brick and examining it under a strong glass found it to be fully as dense at the center as on the surface, there being no trace of either checks, grain or lamination. These brick measured 8½x4¼x2¼ inches and weighed eight pounds each, absorbed less than one-quarter of 1 per cent. and stood a crushing strain of 13,000 pounds to the square inch. They were made from very stiff clay, on the "Grant" brick machine, without re-pressing, and were apparently excellent pavers.

IMPROVEMENT AND CONTRACTING NEWS

PAVING.

Marion, Ohio, is discussing the paving question.

Camden avenue, Canton, Ohio, will be improved.

Brick street paving is being done in Redlands, Cal.

A number of streets in Dayton, Nev., are to be paved.

The main street of Charlotte, Mich., is to be paved.

Golden avenue, Colfax, Neb., will be paved with brick.

Goshen, Ind., will pave its principal streets with brick.

Main street, Venice, Mo., will probably be paved with brick.

Rock Island, Ill., will spend $100,000 in brick paving this year.

A move for better pavements is being made in Madison, Wis.

Jacksonville, Ill., has now twelve miles of finely paved streets.

Several streets in Clarkes, W. Va., are to be paved with brick.

Twenty additional streets will be paved with brick in Toledo, O.

Taylor avenue, Bellevue, Ky., is to be extended and improved.

Ten miles of street paving will be done this year in Streator, Ill.

Deadwood, S. Dak., is improving Forest avenue at a cost of $3,000.

About $300,000 were expended in paving last year in Des Moines, Iowa.

About $7,000 has been expended improving the streets of Comanche, Tex.

Springfield, Ill., business men will establish a $100,000 paving brick plant.

The principal streets of Richmond, Mo., are being graded and macadamized.

Parts of Chicago, Glor and Milburn streets, Buffalo, N. Y., will be paved.

North Second street, Brooklyn, N. Y., will be widened at a cost of $323,000.

Main street, Kenosha, Wis., will be paved and curbed at a cost of $16,340.

Milwaukee and East Eleventh streets, Portland, Oregon, will be macadamized.

Central avenue, from Seventh to Fourth streets, Alamedo, Cal., is to be improved.

Fifty thousand dollars will probably be expended on roads at New Rochelle, N. Y.

Erie street, Jersey City, N. J., will be graded, curved and paved with Belgian block.

The city of Pekin, Ill., is considering the means of raising $27,000 to be used for paving.

The Tampa (Fla.) council has ordered the grading of a number of streets and avenues.

Broadway, De Forrest, Bush and South Fifteenth streets, Seattle, Wash., will be improved.

Proposals will be received until Jan. 6 for the brick paving of Main street, Venice, Ill.

Fort Howard, Wis., has spent about $80,000 for paving and sewers during the past season.

A movement has been started to have Fremont street, Fostoria, Ohio, paved and boulevarded.

Three streets are to be opened between Central Park avenue and Garfield Boulevard, Chicago.

Irving and Milton avenues, San Diego, Cal., will be extended and Logan avenue straightened.

The proposed paving of Cleveland Place, Denver, Colo., will cost $17,470, and of Court Place, $29,000.

J street, Sacramento, Cal., is to be repaved. Asphalt, basalt and granite are being discussed.

Ten thousand dollars will be expended in macamadizing Grand Park avenue, Mamaroneck, N. Y.

The growth of Washington, D. C., during the past year has created a necessity for more street paving.

Julian and San Salvador streets, San Jose, Cal., are to be graded and furnished with stone sidewalks.

A new street is to be opened to extend from Howard street through the marsh, south of Elkton, Md.

Parts of Front, Gambier, Vine, Chestnut, Sugar, Main and High streets, Mt. Vernon, Ohio, are to be paved.

Greene avenue, from Bedford to Nostrand avenues, Brooklyn, N. Y., will be re-paved with asphalt.

Citizens of Oakland, Cal., are protesting against the proposed widening of Broadway and Fourteenth street.

S. M. Harrington has the contract for grading Main street, Lewiston, Idaho. The work will cost the city about $12,000.

A $30,000 country road will be constructed on the division line between Queens and Suffolk counties, New York.

It is estimated that the sum of $32,000 will be necessary to meet the municipal expenses of Fort Howard, Wis., this year.

C. Culver, of Boone, Ia., has the contract for the brick paving of Eighth and Story streets in the business portion of the city.

The report of the city engineer of St. Paul, Minn., shows $94,523 expended for paving, and $24,187 for curbs and gutters during the last year.

An ordinance has been adopted by the city council of Erie, Pa., for the paving of Fourth street, from State to French, with brick.

An effort is being made to have the old Bergen road, between Cator and Greenville avenues, Greenville, N. J., graded and paved.

Parts of Second, Harrison, Main, Brady, Third, Front and Ripley streets and several alleys, Davenport, Ia., are to be paved with brick.

Parts of Fourth, York, Columbia and Isabella streets and Washington avenue, Newport, Ky., will be paved with brick in the early spring.

The city council, of Easton, Pa., is considering ordinances for the paving of two streets with vitrified brick on a six-inch base of concrete.

Twenty-second street, from Monroe to Woodruff avenue, Toledo, O., will be paved. Curtis and Bancroft streets will probably be macadamized.

The contract for paving four squares on George and Market streets, York, Pa., has been awarded to Odenwalt and Huber at $2.97 per square yard.

Assessments have been made for macadamizing Timea street, from Fifteenth to Sixteenth, and Ninth street, from Fulton to Orleans, Keokuk, Ia.

The presentation to the city of Cleveland, Ohio, of the magnificent Gordon park, will call for the construction of many streets and boulevards.

West Sixteenth and Seventeenth streets, from Gaines to Main street, and Spring street from Fifteenth to Eighteenth street, Little Rock, Ark., will be improved.

Parts of Charles street, Dalton avenue and Morris place, Cincinnati, will be paved with brick. Shillito street, from Race to Elm, with be paved with asphalt.

The contract for the improvements around the public square at Wilkes Barre, Pa., has been awarded to Parker & Cullis. The work will not be begun until spring.

Hickory street, from Ninth to St. Louis avenue; Main street, from Twelfth to Nineteenth, and Sixth street from Main to Delaware, Kansas City, Mo., are to be paved.

Parts of Glen Parker avenue, Taylor street, Elm street and Hopkins avenue, Cincinnati, O., will be paved. A brick pavement will be laid on Oak avenue at a cost of $19,242.

Burlington, Ia., laid 50,000 yards of brick paving last year, and is planning for more during '93. The Granite Brick Company, of that city, is furnishing all its brick to the home market.

Ordinances have been passed providing for the paving of Twelfth street, between Frost avenue and Broadway, and Independence avenue, from Grand to Highland avenues, Kansas City, Mo.

Second street, between Market and Green; Green street, between Main and Second, and Church street, between Myrtle avenue and the Richmond road, Ottumwa, Ia., will be paved and curbed.

Bids have been opened for the paving of parts of Dorr street, Western avenue, Wisconsin street and Nebraska avenue, Toledo, O. A protest is being made against the proposed paving of Curtis street.

About four and one-quarter miles of paving, almost all of which is to be cedar blocks, will be laid next season in Minneapolis. The most extensive work will be done on Franklin, Washington and Eighth avenues.

A movement is being made in Nebraska City, Neb., for the paving of First avenue this year. Public improvements in Nebraska City during 1892 were confined almost exclusively to street paving. Nearly $75,000 were expended in this work. The material used is mostly brick.

Street paving in Dayton, Ohio, will be resumed with vigor in the spring. Plans and specifications for the construction of over ten miles of work have already been ordered. Among the streets that are to be paved are St. Clair, Kenton, East Fourth, West Fourth, West Third, Bridge, Brown, Wilkinson and Perry.

There will be expended for street improvements in Boston the sum of $1,280,000. Of this Commonwealth avenue will get $200,000; Columbia avenue, $100,000; India Square, $100,000; Harrison avenue, $225,000; Orchard Park, $60,000, and the Street Paving Department, $100,000.

Street improvements in San Francisco, Cal., will include the extension of Potrero avenue and Post street, the curbing with granite and the paving with basalt blocks or bituminous rock, of parts of Broadway, Pierce, Bluxome, Stevenson and Oak streets. A movement is being made for the repaving of Van Ness avenue.

The Boston board of street commissioners have submitted a report relating to a recent visit made by them to the cities of New York, Brooklyn, Chicago, St. Louis, Cincinnati, Atlanta and Kansas City, for the purpose of examining into the methods adopted by those municipalities in laying out and constructing streets and paying for the same.

Ten blocks of Edgecombe avenue; Westchester avenue, from Prospect to the Southern Boulevard; Twelfth avenue, from One Hundred and Twenty-ninth to One Hundred and Thirtieth street; Fifty-eighth street, from Eleventh avenue to the Hudson river, New York City, will be paved. Boscobel avenue will be opened as an approach to the Washington bridge.

Portland, Oregon, is tired of macadam streets. The subject is being discussed in such a manner as will probably lead to the paving of all the principal streets of the city. A contract has been made for the paving of seven blocks of Morrison street with Trinidad asphalt. The contract has been let for $22,406 for the paving with bituminous rock of Burnside street from First to Washington.

A large amount of street work is contemplated in Peoria, Ill. The following streets will probably be paved with brick: Adams, from Hamilton to Spring; Fulton, from Jefferson to Water; Jefferson, from Wayne to Abington; Hamton, from Monroe to North; Crescent Avenue; First, from Spencer to Seventh; Second, from State to Spencer; Spring; Third and Fourth, from Franklin to Spencer.

The city clerk, of Creston, Ia., will receive proposals until January 23 for paving Adams street, from Walnut to Division, about 10,666 square yards; Pine street, from Mills to Adams, about 4,480 square yards, and Maple street from Mills to Adams about 3,200 square yards; the work to be completed as early as practicable in the spring. The pavement is to be of brick with four inches of sand underneath, five and one-quarter inches of sifted sand between the two courses, and an upper layer of one inch of fine, sharp sand.

SEWERAGE.

Deadwood, S. D., will have a sewer system.

Fort Scott, Kan., is to have a new $15,000 sewer.

A sewer system is being put in at Waxahatchie, Tex.

Texarkana, Ark., is improving its sewerage system.

A system of sewerage is in contemplation for Columbia, Tenn.

Grand Junction, Colo., is agitated over the question of sewerage.

In 1893 the city of Minneapolis expects to lay six miles of sewers.

A ten-inch pipe sewer will be laid on Muzzey street at Chicopee, Mass.

Batavia, N. Y., is considering the question of a complete system of sewerage.

Dickman Bros. are putting in sewer connections on N street at South Omaha, Neb.

Moulden, Fries & Barr, contractors, are constructing a large sewer at Tipton, Ind.

It has been voted by the citizens of Stamford, N. Y., to construct a sewer system.

The sewer system will be extended considerably next year at North Tonawanda, N. Y.

A sewer is wanted in Twelfth street, from Parade to the eastern city limits at Erie, Pa.

A committee is contemplating a general revision of the sewerage system of Washington, D. C.

The aldermen of Lynn, Mass., appropriated $20,000 for sewers in Boston, Tudor and Lewis streets.

The citizens of Reading, Pa., recommend for adoption a sewerage system that will cost about $375,000.

The city of Fremont, Neb., has voted $90,000 sewerage bonds this season for work now being done.

Richard Lowrie was awarded the contract for the construction of a sewer in Lloyd street, Chester, Pa.

The sewer extension work on College avenue, B and Mendocino streets at Santa Rosa, Cal., has been completed.

King & Kennedy have completed their big sewer contract in North Des Moines, Ia. The city's improvements in these underground waterways this year are greater than any year of previous history.

Twenty-two thousand feet of sewer pipe is being laid at Chautauqua, N. Y. The total cost will reach nearly $40,000.

Street improvements ordered and approved by the council of Chicago, Ill., include sewers in thirty-seven streets.

The committee on sewers of the city council of Worcester, Mass., voted to put sewers in Orient and Shattuck streets.

The new sewer system of Phœnix, Ariz., is completed. It can now boast of the best sewers and water-works on the coast.

The people of Kingston, N. Y., have decided to expend the sum of $20,000 on the construction of a complete sewer system.

Harrisburg, Pa., will construct twelve-inch terra cotta pipe sewers in Penn street, Sayford avenue and James avenue.

An order has been presented the board of aldermen of Newton, Mass., laying out common sewers on Chestnut and Hunter streets.

The sewerage question is the subject of considerable discussion at Niagara Falls, N. Y. The minimum estimate of the cost is $126,056.

Tyler, Tex., is to have a sewerage system at once. The system will cover twenty-eight blocks in the principal part of the city.

An extension of the sewerage system is in contemplation from Douglass avenue through Sixth street northward, at Bridgeport, Tenn.

A twenty, eighteen, fifteen and ten inch tile sewer will be built in Clinton street, Buffalo, N. Y., and a twelve inch tile sewer in Newton street.

South Milwaukee, Wis., will have a complete system of water-works and sewerage. Also an electric plant to furnish arc and incandescent lights.

Plans for a sewage system for the entire village have been prepared by DeWitt C. Smith, of Schenectady, N. Y. The estimated cost is $22,000.

Residents of the Twenty-eighth ward have signed a petition for sanitary sewers in six blocks adjoining Taylor and Delmar avenues at St. Louis, Mo.

William Sommer has been awarded the contract for a sewer on North Tenth street to North Grand avenue, and east to O'Donnell street, at Springfield, Ill.

Engineer Van Buren, of the department of city works, of Brooklyn, N. Y., is planning the construction of a sewer system east of Ninth avenue and south of Fifteenth street, and also south of Eastern Parkway, between Prospect Park and Ralph avenue.

The subject of a sewerage commission for the city of Salem and the towns of Beverly, Peabody and Danvers, all in Mass., is being talked of in those places.

Work will begin in early spring on the Third street sewer at Ft. Wayne, Ind. It will be approximately 5,400 feet in length, and its estimate cost will be $38,000.

Sewers will be constructed in Williams avenue, Mississippi avenue, Borthwick street and Kearney street at Portland, Ore. Bids have been opened for same.

Fredin and Wilson will build a sanitary sewer through block 23, Third division, at Duluth, Minn., at a bid of $3,636. The contract is to be completed June 1st, 1893.

The Court street sewer extensions at Pekin, Ill., have been completed. The improvement is permanent and the value of property along that street is largely increased.

Contractors Schneider & Bakorney have completed the Tenth avenue sewer at Cedar Rapids. It is six and a half feet in the clear, 730 feet long, built of brick and cost $6,000.

The outlay for sewers at St. Paul, Minn., during the past year represents a total cost of $234,644.22. Seven and a half miles were laid. During 1893 this will be increased by 24,460 feet.

The Broad street sewer at Chattanooga, Tenn., is declared quite a success. A 20-inch pipe leads to the river, where the wastage is deposited where a moving current carries it away.

Maps and plans have been made by F. K. Baxter, of Utica, N. Y., showing the estimated cost of sewers for Herkimer, N. Y., to be $35,000. The city has been discussing the sewerage question for several years.

The work of excavating for the big sewer of the Tenth ward at Ft. Wayne, Ind., was begun at the foot of Glasgow avenue. F. E. Cole is the contractor, and the cost of the sewer in round numbers is $81,000.

The laying of the Military avenue main sewer-pipe from Platte avenue east to the sewer outlet ditch at Fremont, Neb., has been completed. This line covers a distance of 7,100 feet or about one and one-third miles.

The state board of health has not reported favorably on the proposed system of sewers for Carthage, N. C., as planned by Engineer McComb. Mr. Bogart is engineer for the board and will require the commissioners to change their plans so that the sewage will be carried below the town, involving great additional expenditure, making the cost of the system at least $200,000.

An intercepting sewer will be built along the water front at the foot of Alice, Jackson, Madison and Oak streets, at Oakland, Cal. The improvement will cost between $2,000 and $3,000, the sewer being about 2,000 feet long.

A number of sanitary engineers are surveying the village streets of Westerly, R. I., in order to furnish a plat for a complete system of sewerage to cover the territory included within the limits of the school district.

Work has been commenced on the twenty-four inch sewer on East Davis street. This is the Northern conduit of the terra cotta system. The terra cotta system extends east only as far as East Sixteenth street.

An ordinance has been passed at Seattle, Washington, establishing a public sewer on Third street, beginning at a point thirty feet south of the south line of Columbia street, and connecting with the public sewer on Cherry street.

Tschirgi & Kringle are making slow progress with the Fourth district sewer along Sixteenth street at Rock Island, Ill. All along that street the sewer lies deep below the surface, and the work is rendered much more tedious on that account.

The board of sewer commissioners of the city of Pawtucket, R. I., are making preparations for this year's sewer work by advertising for bids to furnish 1,500,000 hard burned body bricks. Delivery of same is to begin on the 15th of this month.

The material growth of Plymouth, Ind., and the introduction of water-works has made the question of a proper and adequate system of sewerage the most important one the city will have to solve for several years. A trunk sewer has been planned at a cost of $7,750.

A state ditch sewer is to be constructed in Indianapolis, Ind. It will be 11,000 feet long, varying in size from five and a half to ten feet, and will cost $250,000. Preparations for extensive sewer work will be made during the winter and work commenced in the early spring.

James Hillery has contracted with private parties at Washington, Ohio, to build a vitrified pipe sewer from Paint creek to the Worthington block, which will cost $500. The work is now under headway, and will be pushed to completion at once.

An ordinance has been passed at Moline, Ill., for the construction of a sewer, beginning at the west line of Twenty-sixth street at the center of Sixth avenue, thence run west on Sixth avenue to the center of Twenty-third street, thence run north to Fifth avenue, to connect with the sewer on that street.

Sealed proposals will be received by the city clerk of Toledo, Ohio, until January 9, 1893, for the construction of a cylindrical brick sewer, two and one-half feet inside diameter and four inch shell, along the center line of Woodville street from the sewer in Nevada street to the center of Navarre avenue.

City Engineer Thomson is considering a petition requesting some changes in the proposed main extensions of the Lake Union sewer tunnel, at Seattle, Wash. The work in the tunnel proper is in satisfactory progress, and the aim will be to have the extensions completed ready for service when the tunnel proper is done.

At Kansas City, Mo., a public sewer will be constructed along the old bank of the Missouri river from a point east of Santa Fe street to a point near the state line and connecting with the sewer system of Kansas City, Kan. A $29,441.60 extension will also be made to the O. K. creek sewer. Charles Shestedt & Sons received the contract.

Sealed proposals have been advertised at Roanoke, Va., for the construction and completion of the following lines of sewers: Terra cotta sewer pipe, on Jefferson street south, between Campbell and Tazewel avenues, section nine; and between Campbell and Luck avenues and between Henry and Commerce streets in section ten.

The Citizens' Improvement Club of Woodlawn Park, Chicago, are discussing the advisability of asking the city council to pass an ordinance whereby the sewerage system of Woodlawn will hereafter be maintained by the city, and that the property-owners be no longer compelled to undergo an assessment for its maintenance.

Preparations are being made for extensive sewer construction in Chicago next year. Bids for nearly $2,000,000 worth of sewers have been opened. The contemplated improvements are fifty-three in number. Among these improvements is the largest sewer in the city which is nine feet in diameter and seven and a half miles long.

The city board of equalization of Salt Lake City, Utah, instructed the city attorney to draw an ordinance authorizing the assessor and collector to levy the tax for the extension of the sewer system on the property along the east side of Second West street, between First and Second South; the west side of First West street, between First and Second South streets, and on the north side of Second South, between First and Second West.

The people living in the south-west part of the city of Racine, Wis., in the vicinity of Blue river, are circulating a petition to be presented to the council to have a main sewer built this coming summer. During the past season four and a half miles have been completed at a cost of $25,000 and turned over to the city. The members of the board have carefully inspected the work and pronounced it a first-class job in every respect.

WATER-WORKS.

Fergus Falls, Minn., will own its water-works.

The water-works system at Boyd, Wis., cost $6,000.

Kenosha, Wis., will expend about $175,000 for water-works.

Fitchburg, Mass., has appropriated $11,000 for water-works.

Fremont, Neb., has recently spent $29,000 for water-works extensions.

The new water-works standpipe at Dublin, Tex., will soon be completed.

Bids for building water-works at Pittsford, Vt., are wanted until Jan. 10.

Two thousand dollars have been used in extending the water-works at Albion, Nev.

A $4,000 water-works system will be built at the county insane asylum, Racine, Wis.

The contract has been let for a system of water-works in Niobrara, Neb., of $3,600.

The new water-works at Owosso, Mich., will be completed about the middle of this month.

Cannelton, Ind., is to have a new water-works plant, the cost of which will be $50,000.

The Stratford Supply Company offer to sell out to the city of Stratford, Ill., for $100,000.

A new department of public works, the water bureau, is to be established at Chicago.

Fourteen thousand dollars' worth of bonds have been voted for water-works in Kendrick, Idaho.

Twenty-four new filters have been placed in the reservoirs of the Chattanooga, Tenn., city water company.

The Port Huron (Mich.) water board has decided to purchase a 2,000,000 gallon pump at a cost of $41,000.

The Northern Water Storage Company has been incorporated at Denver, Col., with a capital stock of $50,000.

The work of laying new water mains on West Elm street at Peoria, Ill., is being pushed as rapidly as possible.

The laying of the water mains through the different streets of the town of Steelton, Pa., is being pushed rapidly.

Winchester, Mass., has petitioned the legislature for power to issue $100,000 in bonds for water-works extensions.

The Cornell dam, to be built in the Croton river, to increase the water supply of New York city will cost $4,000,000.

The city council of Dubuque, Ia., has decided to buy the plant of the Dubuque water company six months hence.

A $2,500,000 4% fifty year loan for the extension and perfection of the water supply of Boston is under consideration.

The aldermen of Lowell, Mass., have voted for a loan of $100,000 for a driven well system to afford an auxiliary water supply.

The council of Danville, Ky., has authorized John McLeod to prepare plans and estimate for the construction of a system of water-works.

Kearney and Arlington, N. J., are looking for water. It is proposed to sink a series of artesian wells and pump the water into a standpipe.

The city of Rome, Ga., will construct a new $500,000 water-works system. Two reservoirs of 2,000,000 and 3,000,000 gallons capacity, respectively, will be built.

The city of Spokane, Wash., has borrowed $500,000 for the purpose of securing a good water system. It has been decided to spend $312,000 in the laying of pipes.

The citizens of Buchanan, Mich., are agitating the question of erecting a dam in the St. Joseph river to obtain water for a water-works system and electric light plant.

A committee appointed by the Lebanon, Ind., council is making an inspection tour, visiting the water-works of various cities, with a view of estimating the cost of a plant in Lebanon.

When the present improvements are completed, Chadron, Neb., will have a water-works system costing nearly $75,000. A reservoir holding 1,000,000 gallons stands 192 feet above the level of the city.

The water-works question is being agitated at Waukegon, Ill.; Tipton, Ind.; Barnesville, Ga.; Edgefield, S. C.; De Kalb, Ill.; Winthrop, Mass.; Ipswich, Mass.; Winnipeg, Man.; Girard, O.; Ashland, O.; Perrysville, O.; Reading, O.; Cleveland, Tenn.; Celina, O.; Wenatchee, Wash.; McSherrystown, Pa.; Globeville, Colo.; Roodhouse, Ill., and Cameron, Texas.

The long-delayed work on the new intake tunnel at Milwaukee, Wis., has been resumed. The tunnel will cost $160,000. When completed it will have a capacity of 80,000,000 gallons a day. It will not be ready for use before next fall.

Barnesville, Ga., El Paso, Tex., Pittsford, Vt., Meridith, N. H., Waycross, Ga., Albuquerque, N. M., Rockford, Wash., Freemont, Colo., Buchanan, Mich., Ithaca, Mich., Blanchardville, Ill., Groesbeck, Tex., are to have water-works.

Improvements and extensions will be made in the water-works systems of Cottonwood, Idaho, and Newburg, N. Y., Taylor, Tex., Freemont, Neb., Norwood, O, San Diego, Cal., Montgomery, Ala., Lexington, Ky., Chautauqua, N. Y., East Aurora, N. Y., Oskaloosa, Ia., Sioux City, Ia., Santa Fe, N. M., Atlanta, Ill., Port Huron, Mich., Beatrice, Neb., Williamsburg, Tex., and Schuyler, Neb.

Chicago is at last free of its troubles over the water question. At a cost of five years' labor and more than $1,500,000 the four mile tunnel has been completed and is now in use. The pumps now in use have a capacity of 40,000,000 gallons of water every twenty-four hours. When the demand for it arises 130,000,000 gallons can be pumped up every day through this tunnel. The water is perfectly clear and entirely satisfactory.

BRIDGES.

The iron bridge east of Auburn, Ind., is completed.

The Middlefork bridge is completed at Rossville, Ind.

A new bridge is being built over Rock creek at Richland, Kan.

B. Langtry & Sons have finished a bridge at Melvern, Kan.

A new bridge is being built on West Main street at Trinidad, Colo.

A new $50,000 iron bridge is being built on Gay street, Knoxville, Tenn.

A new bridge has been constructed over Falling Run at New Albany, Ind.

The O. & M. Company is putting in a new steel bridge near Medora, Ind.

A new bridge is wanted to span the Colorado river at Wharton, Texas.

Messrs. Hanson and Smith are building a bridge in the town of Norman, Ill.

A new bridge is contemplated on West Seventh street, in New Albany, Ind.

The work on the steel bridge at Leavenworth, Kan., is under way. A dyke and two abutments are to be built this winter.

Aurora, Ill., expects to have a viaduct built over the Q tracks at Lincoln avenue.

A bridge is badly needed between the Second and Fifth wards at Houston, Texas.

Montgomery creek is spanned by a new iron bridge northwest of Knightstown, Ind.

A new iron bridge is being put across Fountain creek at Campbell's station, Tenn.

A much needed bridge has been erected on the North street road, one mile west of Horton, Kan.

The bridge over Temescal creek on Shattuck avenue at Temescal, Cal., is undergoing repairs.

The Detroit Bridge Company are building a bridge at Prophetstown, Ill., in consideration of $25,979.

A substantial iron bridge is now being constructed over Cherry creek, one mile south of Hallowel, Kan.

The town council of Bessimer, Colo., is arranging its finances to build a viaduct across the railroad tracks.

Work has been commenced on the Jacksonville and Southeastern bridge across the Illinois river at Havana, Ill.

Merrill, Wis., is to have a new wagon bridge across the Wisconsin river between the West Side and the Sixth ward.

Work is progressing rapidly on the bridge at the foot of Clinton street across Black river to West LaCrosse, Wis.

The question of bridging the Brazos river in Parker county, Texas, has been revived by the county commissioners.

D. H. Young was awarded the contract for building a new bridge over Cedar river at Chartes City, Ia., in consideration of $10,849.

The Rea bridge across the Sangamon river west of Cerro Gorda, Ill., has been completed and accepted by the board of supervisors.

The county commissioners of Cowley Connty, Kan., will construct a new bridge across Walnut river in Creswell township, that county.

J. L. Bayley was awarded the contract for constructing a bridge over Hangman creek on the Medical Lake road from Spokane, Wash.

Two new bridges will be built at Weatherford, Tex; one across Butcher branch, between Oak and Columbia streets and one on Walnut street.

The bridge being constructed at Montezuma, Ind., is beginning to take on a bridge-like appearance. The first span on the east side is completed.

The Fifth street bridge at Atchison, Kan., is to be repaired and a new bridge will span White Clay creek on Santa Fe street near St. Louis college.

The Victoria bridge over the St. Lawrence at Montreal is two miles long, cost over $5,000,000, and contains 10,500 tons of iron and 3,000,000 cubic feet of masonry.

The Llano bridge, at Llano, Texas, which has been in course of construction for some time past, is completed. It is 800 feet long, four spans, crossing the Llano river and cost about $40,000.

The St. Louis and Madison Bridge and Transfer Company, with a capital stock of $350,000, will be organized under the Illinois law to build a wagon way and electric street car line over the merchants' bridge in North St. Louis.

STREET LIGHTING.

Yoakum, Tex., will be lighted by electricity.

Anderson, Ind., is to have a $35,000 electric plant.

Nuda, N. Y., is to be illuminated with electricity.

Electric street lights are soon to be used in Holly, Mich.

A $10,450 electric plant will be erected in Fayette, Mo.

Brownwood, Tex., will soon be lighted with electricity.

Franklinville, N. Y., will probably be lighted by electricity.

Schuyler, Neb., will spend $7,500 in additional electric lights.

An electric light plant is to be established at Hillsdale, Mich.

Arrangements are being made for electric lights at Knowlton, Que.

Lexington, Neb., has voted to bond the city for the purpose of putting in electric lights.

The citizens of Madison, Neb., have voted to issue bonds for $3,500 for an electric light plant.

PUBLIC PARKS.

Orange, Cal., has two parks under way.

A public park is talked of in Rockford, Ill.

Anaheim, Cal., is arranging to construct a park.

Shawnee Park, Louisville, Ky., will be improved.

Ogden, Utah, will issue bonds to the extent of $50,000 to build public parks.

The city council of Moscow, Idaho, has taken steps to beautify the city park.

The capitol grounds at Austin, Tex., will be improved by an artificial lake, bronze statues, etc.

A tract of land southeast of Ogden, Utah, will probably be purchased by that city for a park.

A new park covering two blocks is under contemplation by the North Side Improvement Association, Sioux City, Ia.

An irregular piece of ground containing about three acres has been leased by the city of Redlands, Cal., for park purposes.

Work is progressing on the new Sportsman's park at St. Louis, Mo. It is proposed to make the bicycle track there one of the best in the country.

The park commissioners of Council Bluffs, Ia., have on hand $6,000 in ready money and propose to spend it by adding another to an already fine system of parks.

Mayor Washburne, of Chicago, suggests that the Lake Front park should be improved, and that the water front should be ornamented by an esplanade and harbor.

By the will of the late W. J. Gordon, Cleveland, Ohio, has recently become the recipient of a large park. A boulevard is proposed to connect this park with Wade Park.

The improvements of the public park of Oshkosh, Wis., have been stopped for the season. Fully $20,000 more will be expended before the improvements are completed.

STREET RAILWAYS.

Cleveland, O., has electric heaters in street cars.

The subject of an electric railway in Kendallville, Ind., is being discussed.

Toronto, Ont., will have its street cars operated entirely by electricity in the near future.

An elevated belt line for the joint use of the several electric railways in operation in the suburbs of Chicago, is proposed.

The Worcester and Milbury Street Railway Company, Worcester, Mass., propose an extension of their line to Southbridge and Charlton.

A New York syndicate has bought the street railway system of New Orleans for $10,000,000 and will change the motive power from mules to electricity.

The Citizens' Street Railway Company of Detroit will contract for the construction of fifty accelerator cars for its several lines, to be operated by electricity.

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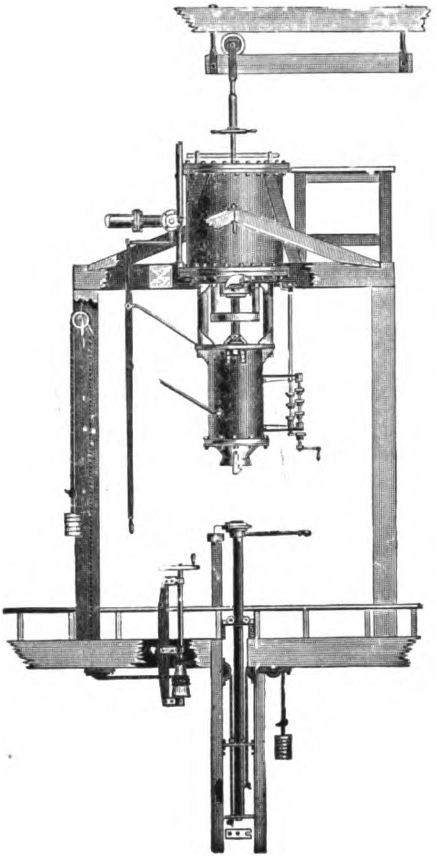

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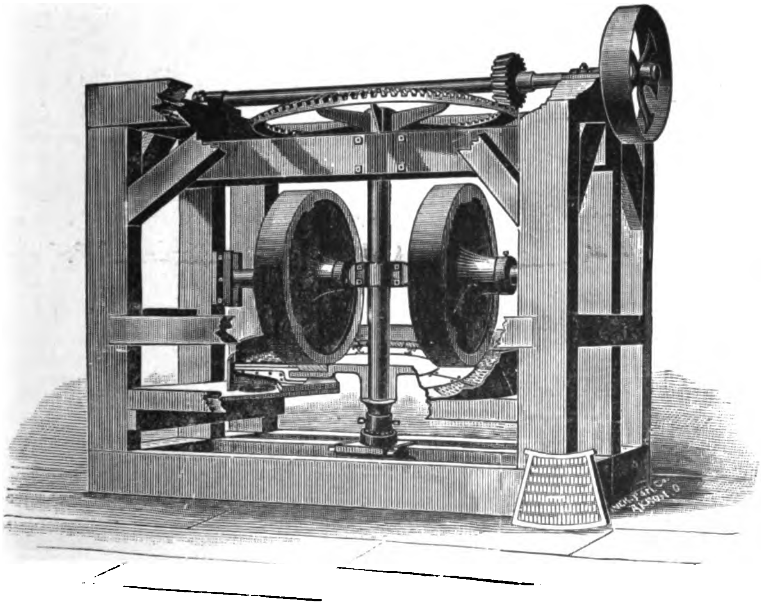

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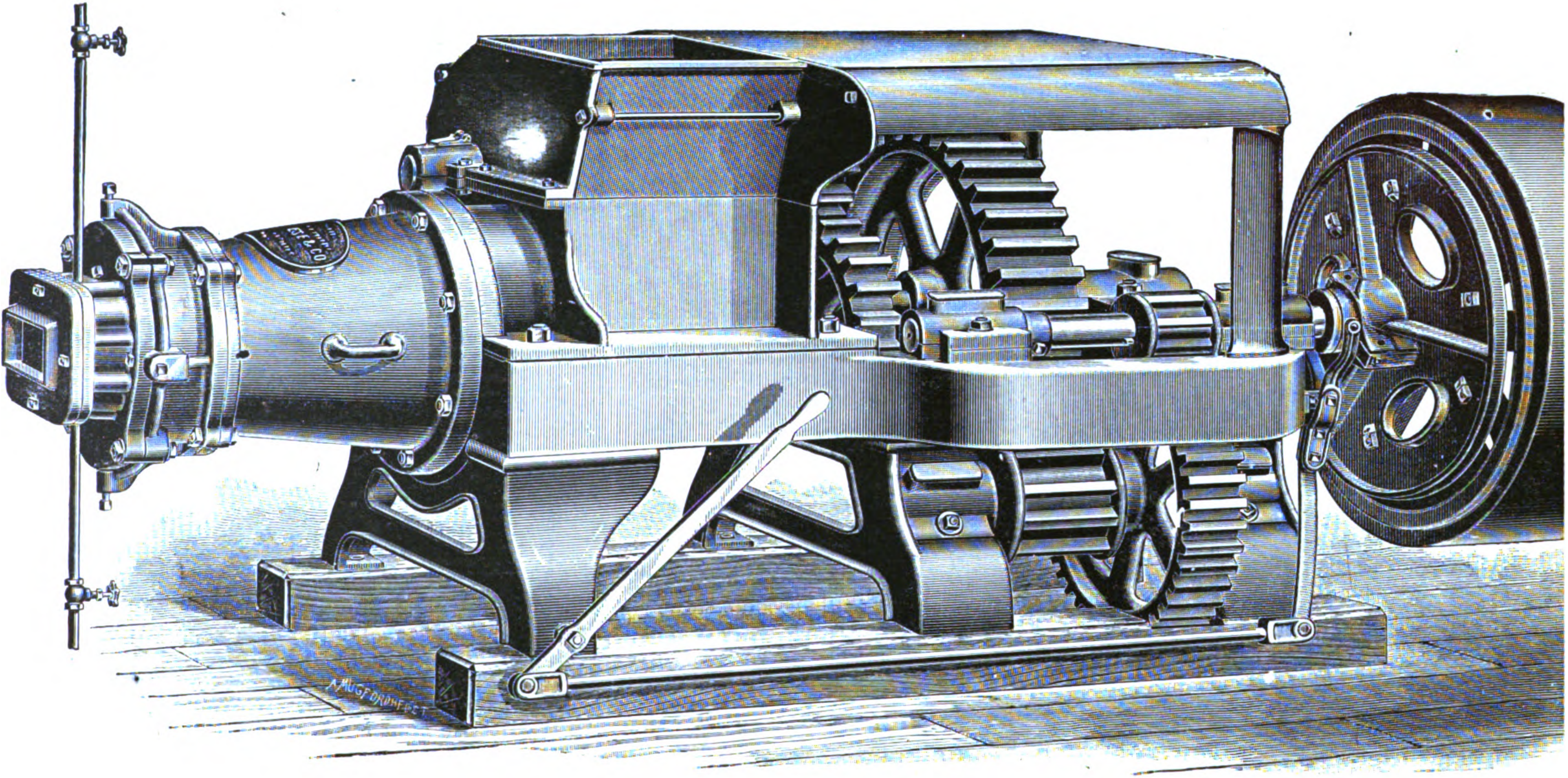

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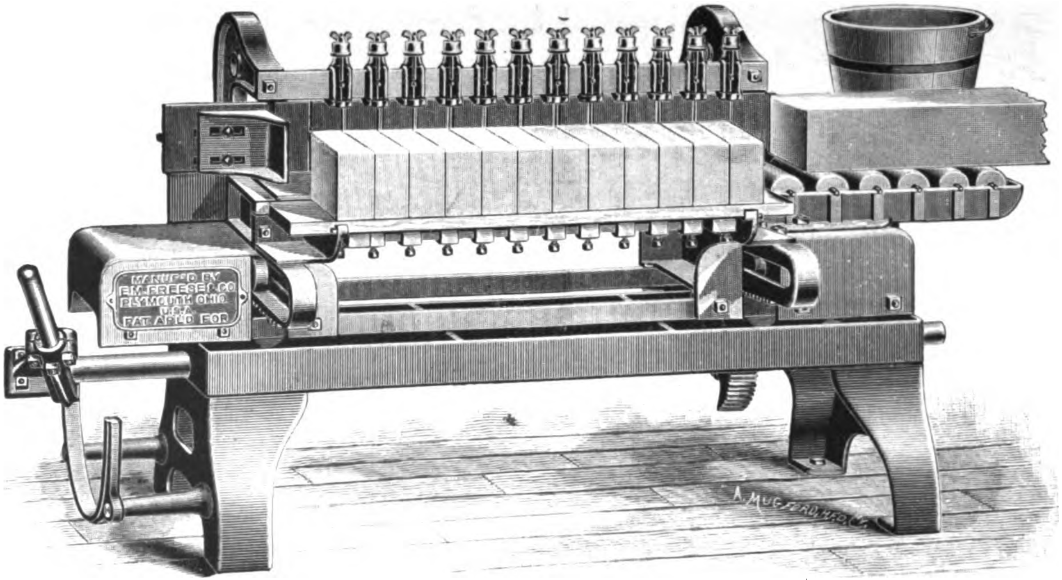

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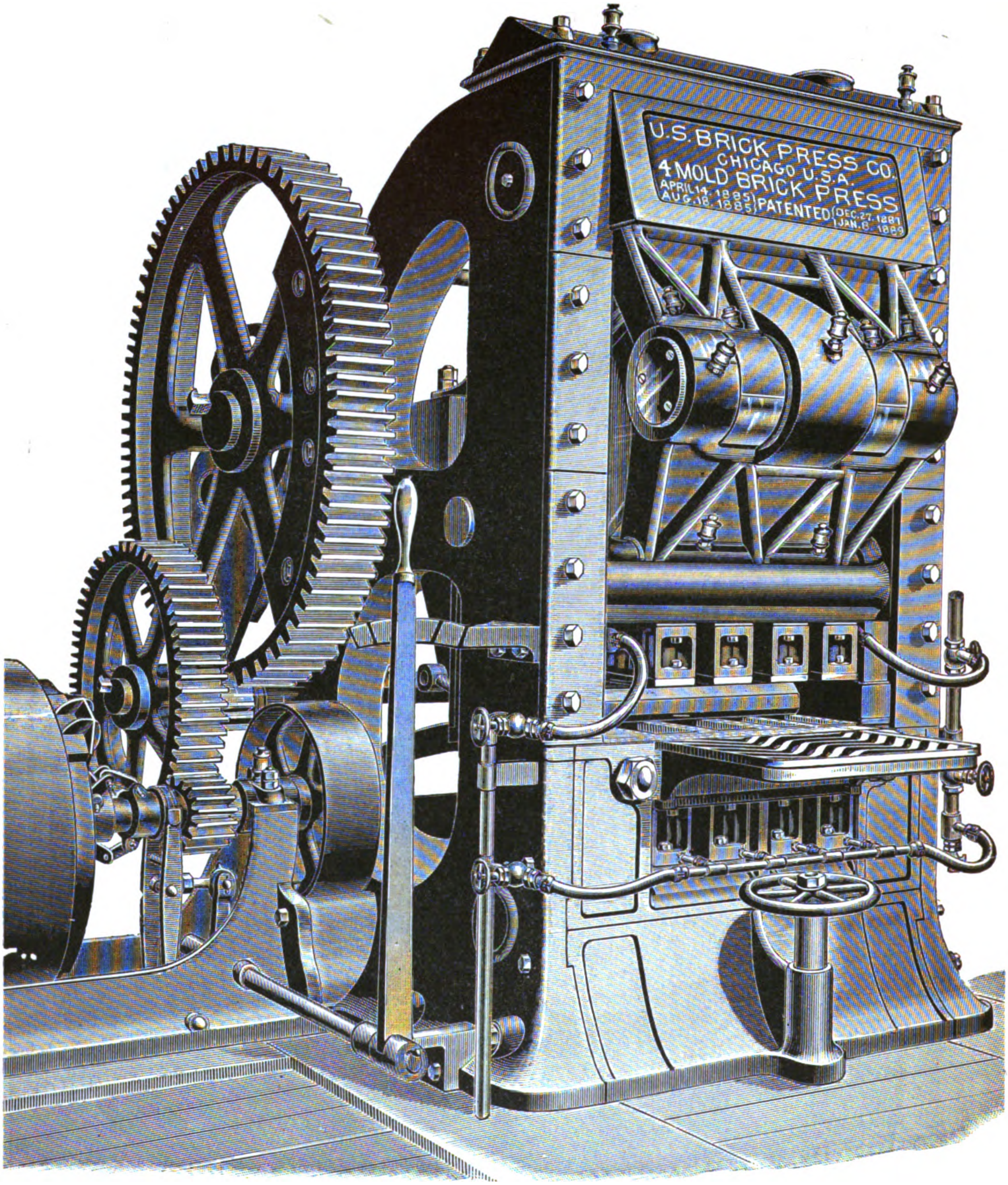

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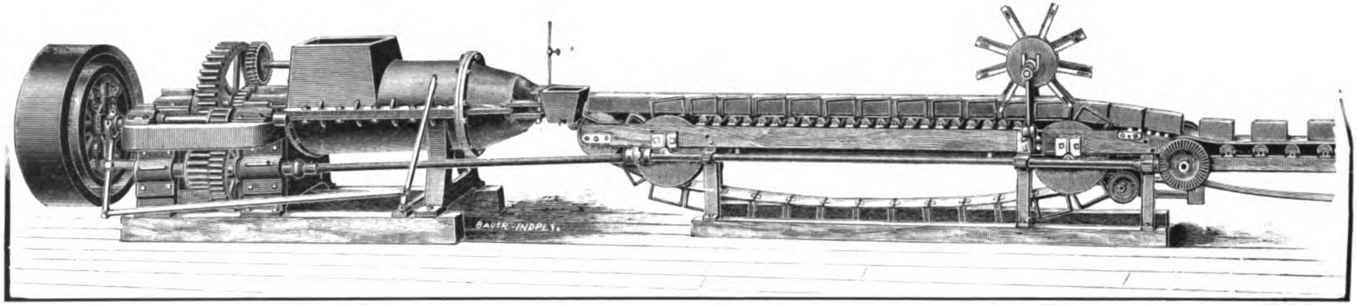

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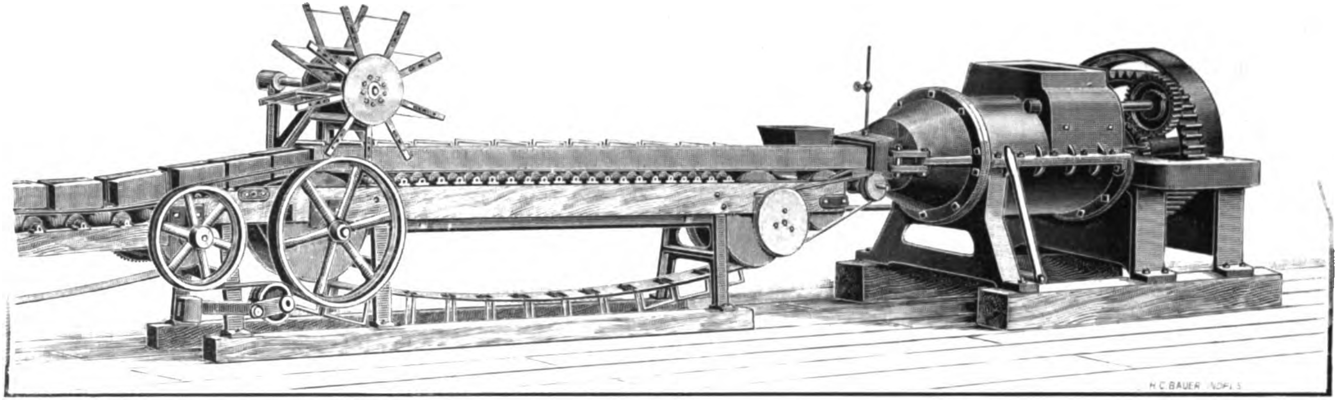

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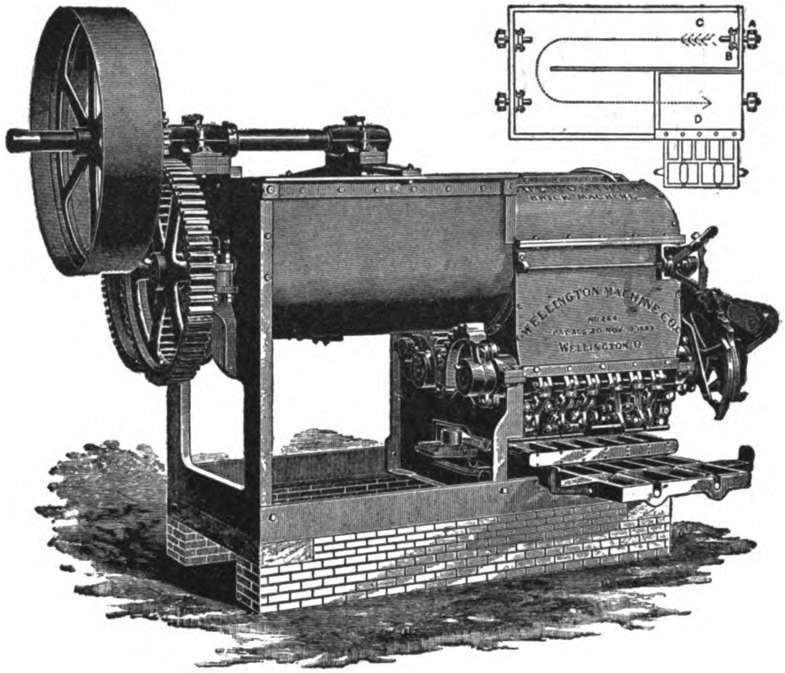

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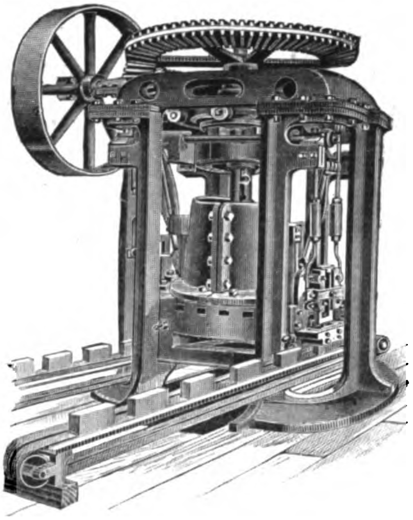

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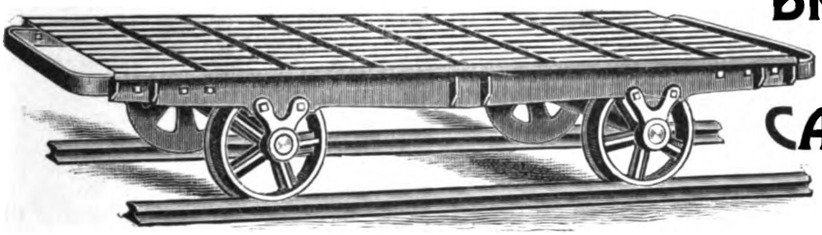

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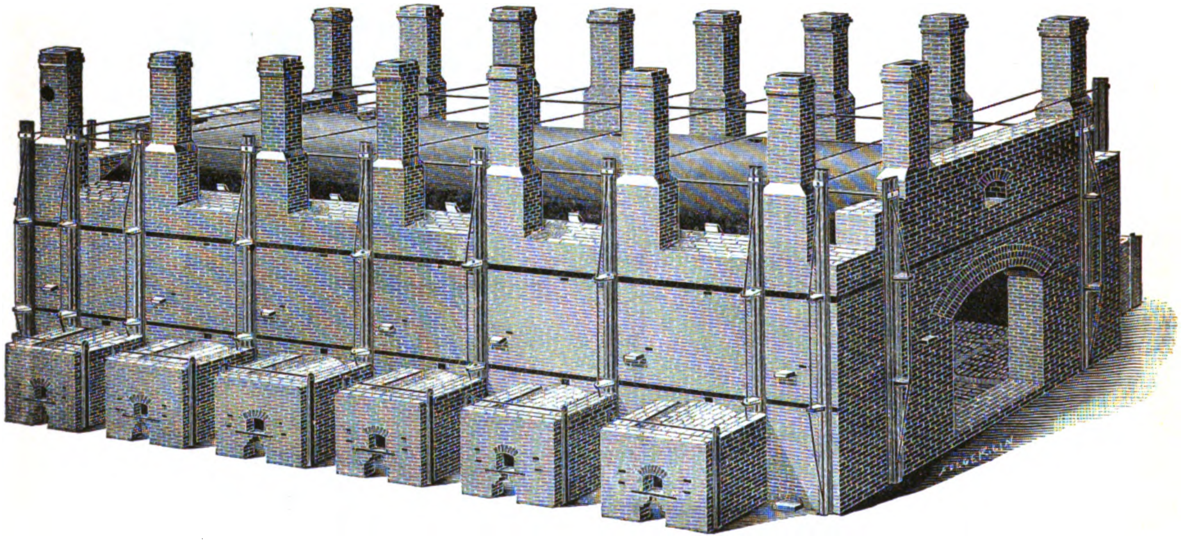

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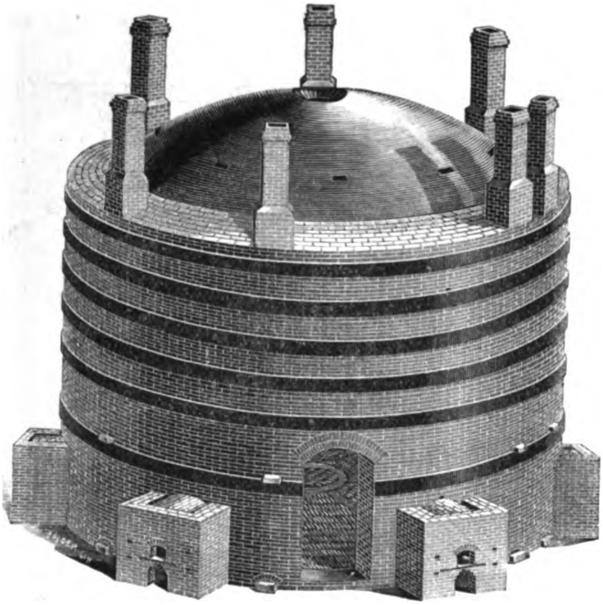

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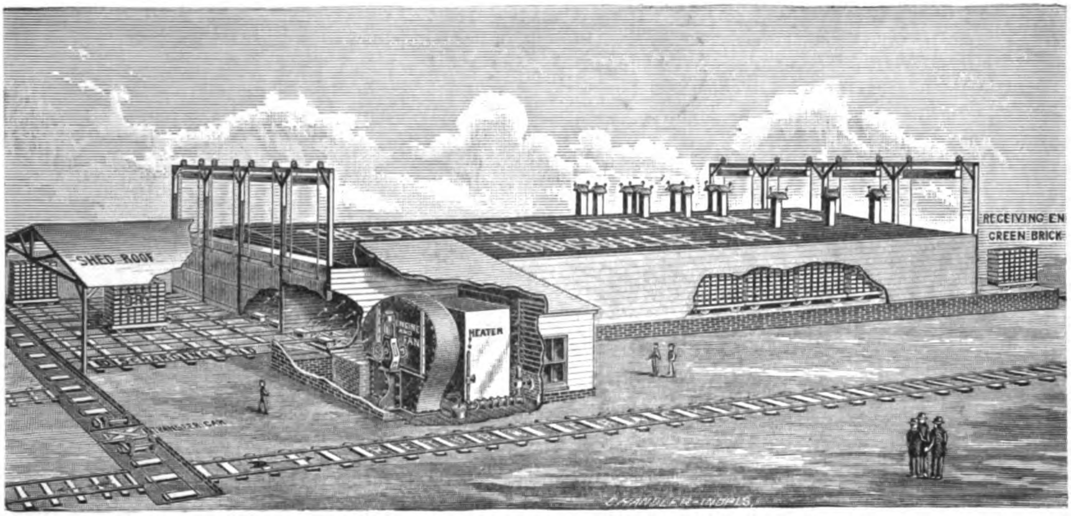

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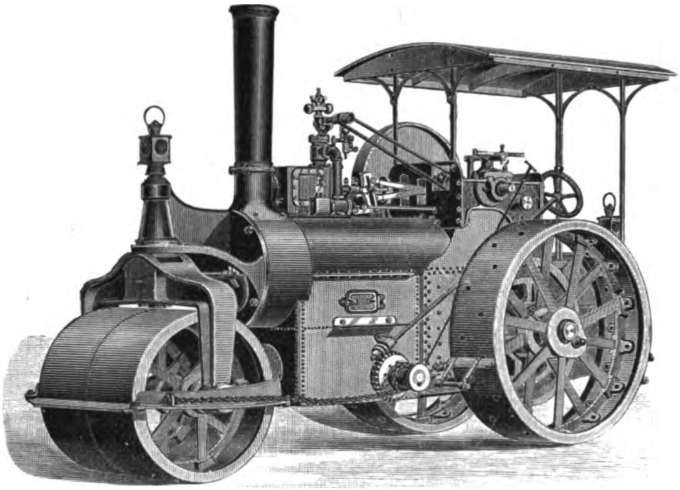

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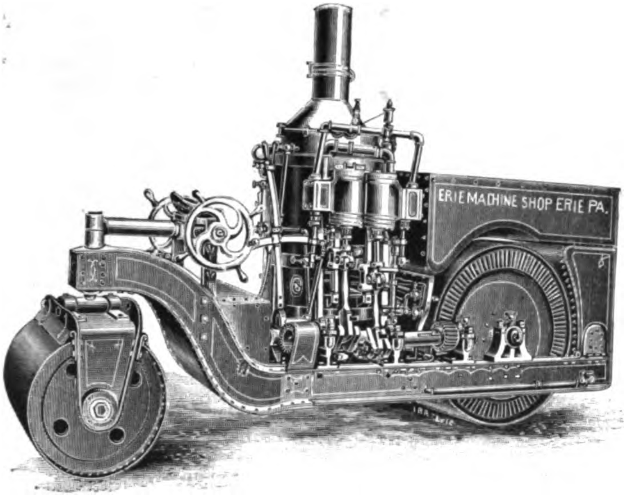
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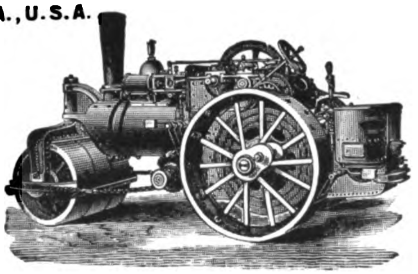

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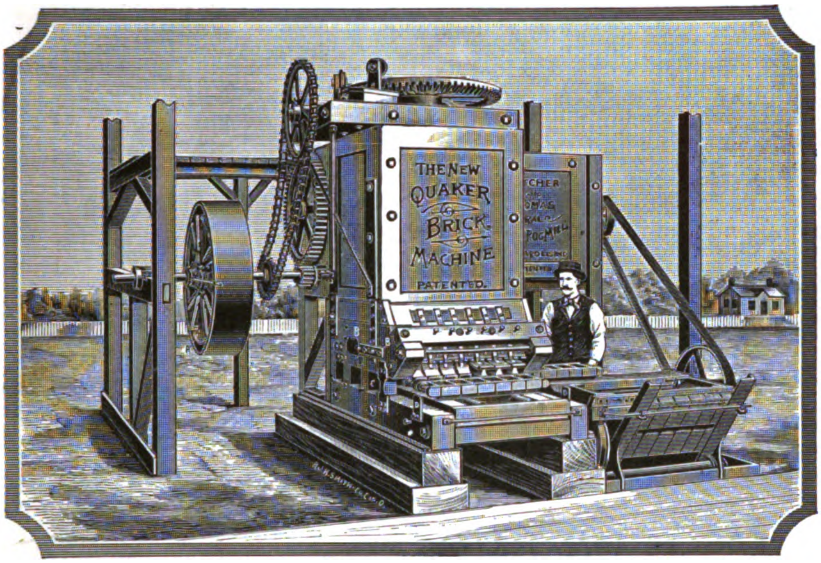
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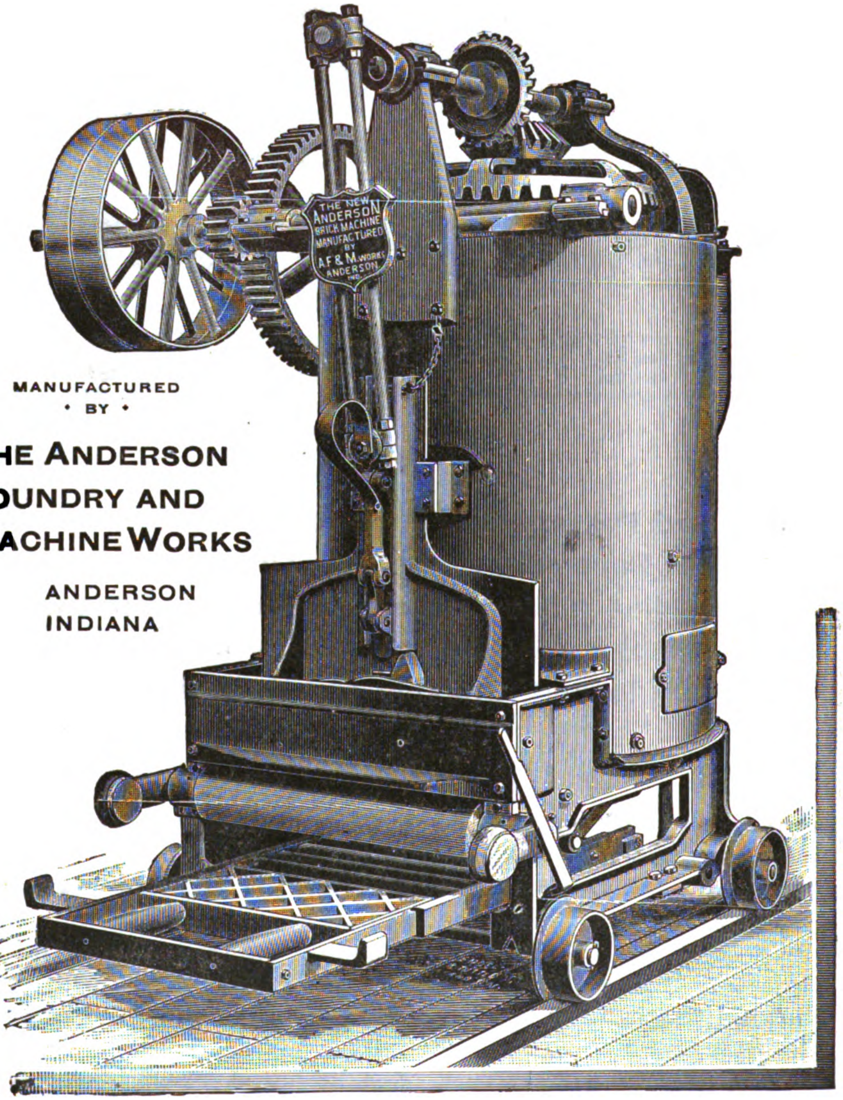
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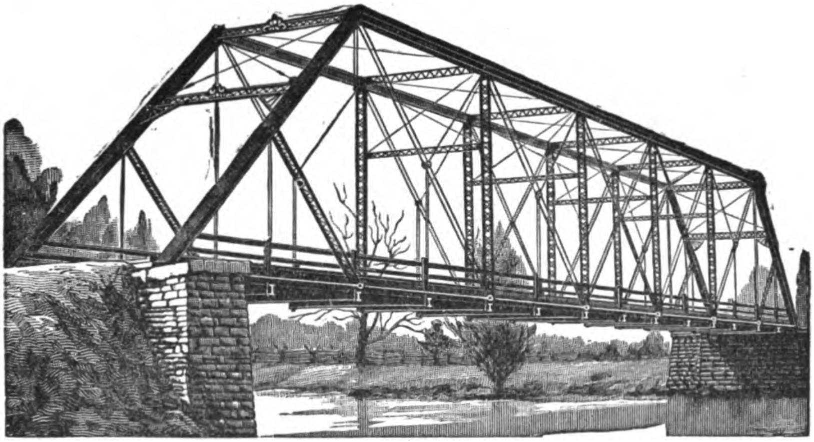

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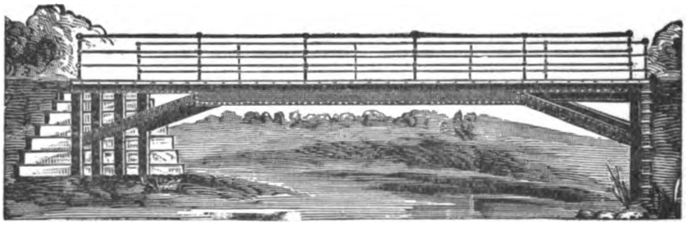

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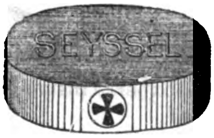

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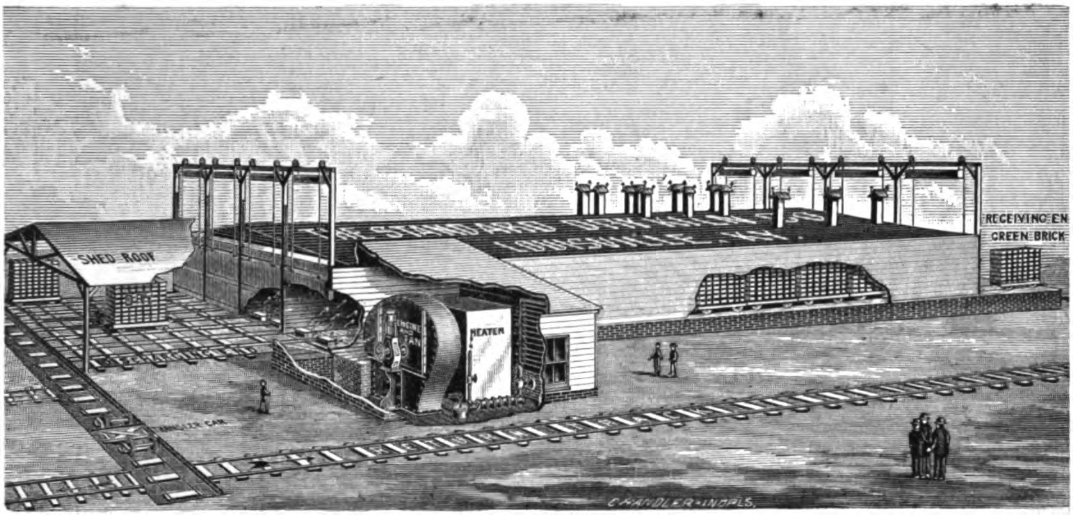

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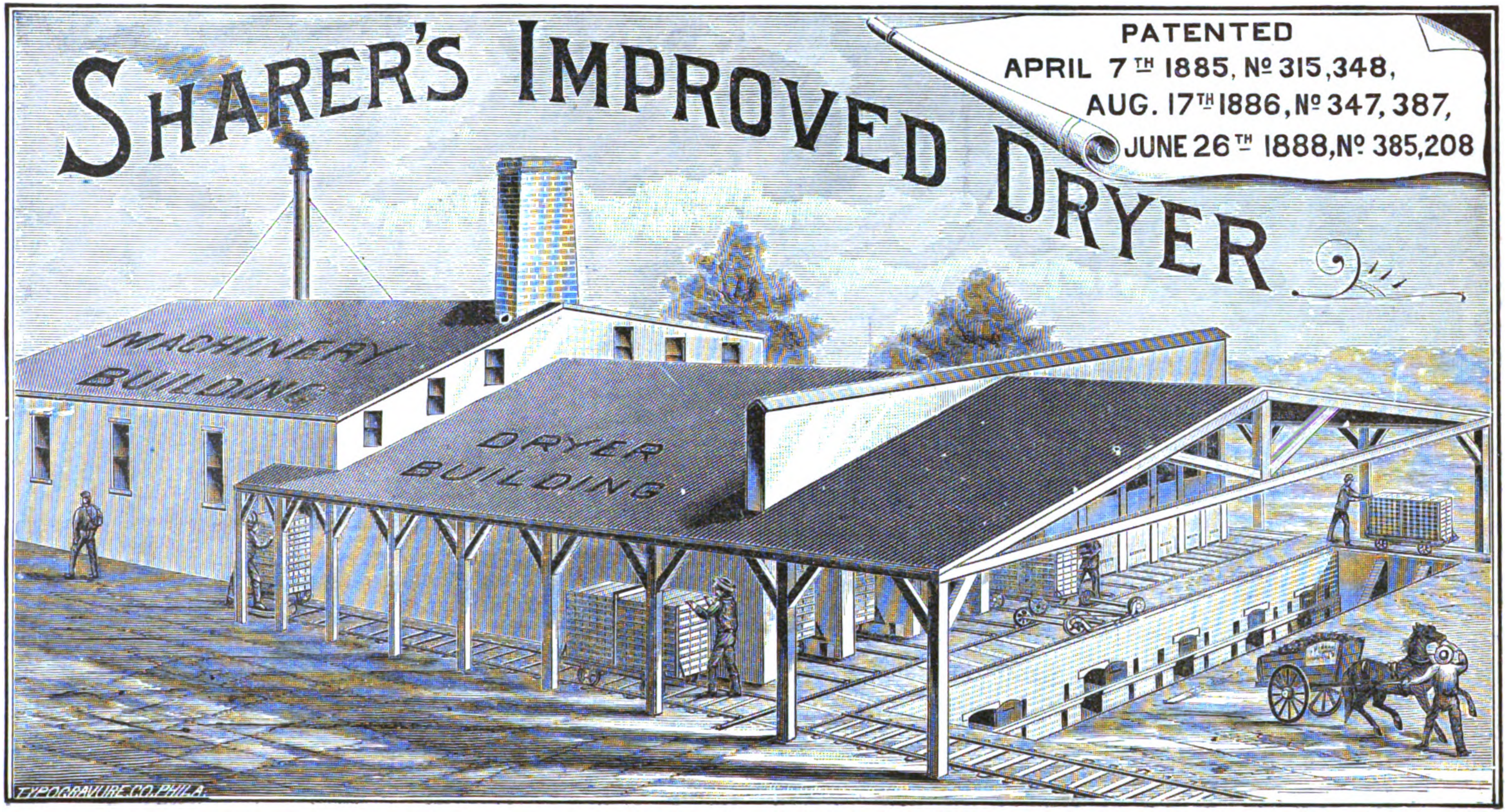

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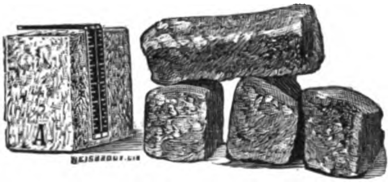
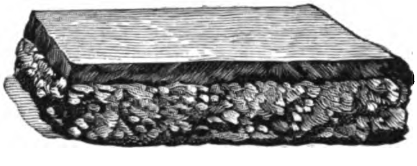
WE ASSERT THAT THEY ARE, AND SUBMIT BELOW SOME EVIDENCE TO PROVE IT.

GRANITE PAVING BLOCKS are everywhere accepted as the standard of durability among paving materials.

Race Street, Cincinnati, was paved with asphalt in 1886, and at the same time the car tracks at the intersection of Fifth and Race were paved with granite blocks. This granite pavement became practically worn out after six years of service, and was taken up and renewed by direction of the City Engineer.



(Figure 1.)



(Figure 2.)

Figure 1 (from photograph) shows how the old granite blocks looked when taken up, as compared with the original standard block marked "A." According to the City Engineer's census of travel, this pavement was subjected to 318 tons of travel per square foot per day, or a total of 696,420 tons during its life of six years.

Figure 2 (also from photograph) shows a block cut from the center of Race Street, between Sixth and Seventh Streets. This pavement carried 204 tons of travel per square foot per day, or 260,610 tons up to the time this block was cut out. The asphalt had lost no appreciable part of its thickness at that time.

Race Street, according to the City Engineer's census, is the heaviest traveled street in Cincinnati. The pavement is now, after six and one-half years' service, in first-rate condition. It has carried in that time 484,000 tons of travel per square foot of surface—more than any brick pavement yet laid will be required to carry in a life of twenty years. The pavement was guaranteed for five years free of cost, and is now under contract to be kept in repair for a second period of five years at a cost of about 46 cents per square yard.

The original cost per square yard was - - - - - - -	**$2.90**
Add cost of repair for second five years, - - - - - -	**.46**
Total cost of pavement per sq. yd. at end of 10 years, -	**$3.36**

In that time the street will have carried, at present rate of travel, 744,600 tons per square foot without one cent of cost to the city for repairs, except as stated above.

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II.

FINANCIAL ADMINISTRATION.

Most travelers and many Parisians regard Paris as synonymous with France. The traveler visits Paris and finds even a few months too short to exhaust its resources. The true Parisian becomes so imbued with the idea of the importance of the French capital that he exaggerates it, and often calls it the capital of the world. At times it has almost amounted to this. But as the Saxon races advance, the Latin races and their allies seem to recede. Paris is no longer the leading city of the world, except in the beauty of its general construction and its vast art treasures and productions. A city attempting to make human existence in every way agreeable, must spend more than many entire nations. Paris does this. It is for the student of sociology to decide whether this object is attained or not. The student of science knows that everything human is but an approximation. I have met, however, several Parisians who regard Paris as little short of Heaven. But I fear even they have at times their doubts. Certainly, in its material equipment, Paris is an example of what can be done when engineers, architects, science and finance combine and honestly administer affairs.

To estimate, collect and disburse, economically, correctly and honestly the enormous sum of 290,117,046 francs ($58,023,409) in one year, means to operate a gigantic and complete financial ma-

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chine, well worthy of our attention. This was the total municipal expenditure of Paris in 1892.

A brief summary of the sources of this revenue, and of the objects for which it is paid out, is all that is possible in the present article. An analysis of the disbursement for the subdivisions of the public work is very interesting, but it is necessary to treat of these topics separately; setting forth, for example, the cost of the streets and the different kinds of pavement and their constant maintenance. Paris paid out in 1892, upon its streets and avenues, 22,890,100 francs ($4,578,020), of which 20,719,700 francs ($4,143,940) was for maintenance and cleaning of street pavements and sidewalks. This represents about what is done every year. The analysis of Paris paving would make an article alone.

The Prefect of the Seine, who is the chief mayor of Paris (the city being divided into twenty arrondissements or divisions with a mayor over each), is chief executive officer. Among other general matters he has charge of the estimates of the funds needed for city expenses. He causes the budget or estimate of the tax levy and income and the appropriations to be drawn up once a year for the following year. It is called "the budget." It contains the details of the expenses of the previous year; the amounts proposed by the prefect. A little later the amounts approved by the municipal council are added and the amounts finally approved by the Minister of the Interior of France. All are arranged in parallel columns. The budget is carefully printed in two documents, one of about 275 pages, twelve inches square, which, while complete enough for usual information, is but an abridgment of a larger publication of more than 3,000 pages, called the *Développements Justificativs*. This large book of estimates contains the details. It can be had by any student of finance or other person, showing a reason why he can profitably use it, by application to the prefect. The smaller one, ample for practical matters, can be usually had for the asking. A study of these documents is very interesting and instructive.

Statistics, properly tabulated, when carefully and understandingly studied, form a means of information which can be obtained in no other way. They are the means of suppressing evil results and extending good ones.

While our American cities surpass most European cities in many ways, nevertheless they lack properly analyzed and properly prepared statistics, covering past experience. This fact makes their administration very difficult for our city officials, deprived as they are of this experience of their predecessors. Our short terms of office make tabulated experience all the more necessary, especially in departments of public works. More than enough money is wasted annually in every large American city than is needed to pay for an expert statistician, who would indirectly save thousands of dollars and prevent much inconvenience to which new officials and the public are repeatedly put.

The budget is divided into two parts, called the *service ordinaire* and *service extraordinaire*, *i. e.*, the *usual estimates* which provide for the regular annual and running expenses of the city, and the unusual or *special estimates* which provide for unusual expenses and improvements, not in the nature of renewals. They are applied to additions or extensions of the water-works, main sewers, etc.; in short, what a private corporation would call permanent increase of plant.

Notwithstanding great care on the part of the prefect, the municipal council, the secretary of the treasury and the secretary of the interior, every collection and disbursement is not always provided for in advance. In this case an additional budget is passed. It adjusts a few accounts and provides that certain appropriations can be held over to pay for work of long duration.

To follow the finances to their close we must consult the *comptes generaux* or general account books of the book-keeping division of the financial department. These books are not printed and given to the public. It would be impracticable. But they are open to inspection upon application, as they should be. But the principal items and a tabulated summary is printed in the first column of the budget for the succeeding year, as a basis for estimates.

The following (Table I) is condensed from the budget of 1892. While slightly above the average amounts of the past twelve years, nevertheless the items given are a fair statement of the cost and divisions of the expenses of Paris :

TABLE I.

SUMMARY OF PARIS BUDGET FOR THE YEAR 1892.

Compiled and Translated by J. W. Howard.

[NOTE.—Estimated on a basis of 5 francs, equal to $1. To get exact results, take 96% of amounts given in table, because 5.21 francs equal $1.]

REGULAR RECEIPTS.

SOURCES OF COLLECTIONS.

1.	**Octroi, or toll on food and materials**	**$28,751,871**
2.	**Direct tax upon property, horses, carriages, dogs, etc**	**6,415,020**
3.	***Receipts from gas companies' taxes, etc.***	**3,942,740**
4.	**Water supplied to private persons and companies**	**2,614,782**
5.	**From the state as its share of the cost of Paris police**	**1,596,513**
6.	**Public market places and buildings**	**1,565,528**
7.	**Fines and permits. Interest on deposits**	**1,243,000**
8.	***Public conveyances, omnibuses, horse-cars, etc***	**1,141,240**
9.	**Receipts and tuitions in certain schools. Legacies**	**944,964**
10.	**From the state as its share of maintaining and cleaning streets**	**680,000**
11.	**Reimbursement of the city for advances due to private constructions**	**713,753**
12.	**Rents and fees from the abattoirs, or slaughter-houses**	**622,000**
13.	***Rents of newspaper and other stands upon streets and parks***	**620,040**
14.	**Public storage and warehouses**	**618,190**
15.	**Special charges for cleaning private streets, etc**	**594,000**
16.	***Rent of private telegraph and telephone lines under streets; private sewers***	**529,160**
17.	**Sale, etc., of lots in the cemeteries of the city**	**467,571**
18.	**Miscellaneous; sale of official newspaper, use of firemen, etc., at theaters, etc**	**376,297**
19.	**Rents from lessees of theaters and property of the city**	**371,820**
20.	**Burial permits, undertakers, etc**	**182,002**
21.	**Miscellaneous licenses to use the streets**	**180,000**
22.	**Sale of old materials from pavements, etc**	**69,280**
23.	**Public scales and weighers' fees**	**59,600**
24.	**Copies of deeds of sale, and taxes on the same**	**49,600**
25.	**Private donations of income from endowments for charity**	**6,038**
	Total of regular receipts	**$54,354,009**

SPECIAL RECEIPTS.

1.	**Contributions of the state, etc., to restore deeds destroyed in 1871**	**9,400**
2.	**Interest upon deposits of special funds**	**100,000**
3.	**Sale of city real estate**	**40,000**
4.	**Sale of city real estate and extra materials**	**60,000**
5.	**Miscellaneous receipts**	**18,000**
6.	**Product of special loan authorized in 1886**	**3,400,000**
7.	**Sale of real estate and building materials from 1886**	**20,000**
8.	**Special appropriation of 1891, held over**	**22,000**
	Total of special receipts	**$3,669,400**
	GRAND TOTAL OF COLLECTIONS, OR RECEIPTS	**$58,023,409**

REGULAR EXPENSES.

OBJECTS OF DISBURSEMENTS.

1.	Payments of interest and part of principal of city debt	$21,550,095
2.	*Regular public schools of all grades*	4,940,678
3.	Police department and courts	4,840,822
4.	Public hospitals. Help for the poor. General charities	4,794,111
5.	*Maintenance pavements, $2,298,460. Sidewalks, 469,300. St. cleaning, 1,314,400. Gen'l, 61,780*	4,148,940
6.	*Public parks. Public lightiny. Inspection of public conveyances*	2,876,875
7.	Administration of octroi or toll on food and materials	1,708,726
8.	*Maintenance and cleaning of sewers*	1,704,540
9.	Administration of the prefects and offices, finance department, etc	1,492,265
10.	Shares of state tax, collection of taxes, etc	1,214,460
11.	*Administration of the public works and supplies of Paris*	964,428
12.	*Maintenance and construction of city buildings, architecture and art*	889,402
13.	Reserve funds, emergency expenses	719,798
14.	The Republican Guard, a special local force	585,540
15.	Fire department	584,928
16.	Surveys of streets, etc. Plans of city, control of building lots, etc	434,080
17.	*Subsidies and other aid to higher institutions of learning*	306,652
18.	Administration of market places and buildings, etc., of the city	259,390
19.	Administration of the cemeteries	250,136
20.	*Pensions to old employes of the city, all classes, or their widows, etc*	238,135
21.	Military expenses, etc	195,630
22.	Administration, etc., of the 20 offices of the sub-mayors	176,390
23.	*Municipal chemical laboratory*	56,650
24.	Miscellaneous, astronomical, meteorological and scientific, etc	21,538
25.	Commission to examine, etc., drivers of public conveyances	5,500
	Total of regular expenses	$54,354,009

SPECIAL EXPENSES.

1.	Restoring records and deeds destroyed by the commune in 1871	17,200
2.	Purchase of real estate	111,000
3.	Extensions of main sewers	60,000
4.	Reserve for emergency expenses	39,200
5.	Laying out new sections of city, increase of water-works, etc	3,400,000
6.	Miscellaneous public permanent improvements	20,000
7.	Special bills held over from 1891	20,000
8.	Special bills held over from 1891	2,000
	Total special expenses	$3,669,400
	GRAND TOTAL OF DISBURSEMENTS OR EXPENSES	$58,023,409

To better grasp the financial investments and standing of Paris, I have drawn up Table II, which gives the condition of the debt of Paris in 1892:

TABLE II.

DEBT OF PARIS.

(**NOTE: For exact value of money in 1892, deduct 4 per cent. from items given.**)

Divisions of Debt.	Original Debt.	Repaid Previous to 1892.	Paid During 1892.	Due After 1892.	Interest, etc., 1892.
Bonds or loans, general	$451,859,290	$82,065,438	$5,180,499	$364,113,858	$19,019,589
Bridges, canals, water-works, etc	29,757,218	11,657,829	580,006	17,569,384	1,078,280
School buildings, etc	906,810	108,708	26,236	771,866	27,129
Totals	$582,023,318	$93,831,975	$5,736,741	$382,454,608	$20,124,998

When we remember that labor is cheaper in Paris than in America and that the city officials are paid about one-half what we must pay them here, we understand at once the greater purchasing power of money in Paris. In order to compare Paris with what a city similarly equipped and as well administered would cost if in the United States, we must add from twenty per cent. to twenty-five per cent. to the items given for Paris; or *vice versa*, by deducting about these per cents. from the expenditures of the American cities, we bring them to the French basis of cost. But the fact remains that rapid growth and other causes have prevented most American cities from enjoying such efficient and permanent improvements as Paris enjoys. There are a few prominent exceptions which show what our cities can do when trained and honest men are put in control; men willing to investigate and profit by the experience of other cities; men above any temporary or passing influence and who regard a city as an organism the future health and prosperity of which is to be respected as well as the present needs.

Paris, indeed, spends a vast fortune annually, but as a rule, wisely; producing experience and results freely open to all to profit by and to enjoy.

It will be noticed that real and personal estate are not the basis of the income of the Parisian treasury. It is evident from an examination of Table I that the direct tax on real and personal estate constitutes only about 11 per cent. of the income of the city. According to the law of France, revised April 5, 1886, the *population* of Paris is the basis of taxation. This means that a method exists of taxing the 2,344,550 inhabitants of 1892 according to what they possess and consume. This is done effectively by the celebrated *octroi* or toll levy upon all supplies of food and raw materials crossing the city limits into Paris. This is an indirect tax. While amounting to fifty per cent. of the income of the city each year, it is the least felt by the individual citizen.

The following (Table III) shows the amounts collected at the many points of entrance into Paris by the employees of the octroi or toll department:

TABLE III.

PARIS TAX ON FOOD AND RAW MATERIALS.

(*An Average Year.*)

Classes of substances taxed.	*Collected in 1888.*
Beverages of all kinds	**$11,766,648**
Alcoholic medicines	**57,014**
Liquids other than beverages	**3,245,905**
Provisions or food of all kinds	**6,382,223**
Toll on live cattle passing through on foot	**397**
Fuel of all kinds	**2,749,727**
Building materials	**1,472,727**
Lumber, boats, etc	**909.042**
Fodder	**991,879**
Miscellaneous articles	**477,402**
Small collections	**2,512**
Fees at the warehouses	**64,620**
Certificates to take out and return material, etc	**18,165**
Fuel used at factories	**98,849**
Total	**$28,231,805**

In these days of discussion of city franchises, it is very interesting to glance at what Paris has done in the matter of granting franchises to the gas, electric light and street car corporations. It is instructive to learn what Paris makes these companies pay for the use of the public property of the city; that is to say, for the use of the streets. The city authorities, with wise foresight, arranged that while these companies can earn reasonable profits they must pay handsomely for the use of the city streets. These streets have cost enormous amounts to establish, grade, pave and otherwise equip and beautify, both above and below ground; and they must not be given away, in part even, for nothing.

The gas companies pay an annual royalty of 14,000,000 francs ($2,800,000); also 2 centimes per cubic meter (11 cents per 1,000 cubic feet) of gas sold; also a rental of 200,000 francs ($40,000) per year for the use of certain portions of the underground passages and sewers. The city received in 1892 from the gas companies a total of 19,713,700 francs ($3,942,740), or 6 per cent. of the municipal income.

The horse car and omnibus companies paid a tax of 2,000 francs ($400) per car or vehicle per year, making a total for these companies from this and other charges of 2,146,200 francs ($429,240). Other public conveyances and carriages paid in 1892 3,560,000 francs ($712,000). The total income of Paris from horse cars, omnibuses and public vehicles was 5,706,200 francs ($1,141,240), or 2 per cent. of the city expenses.

The extension of the city means additional streets, sewers, pavements, etc. These call for increased expenses. This annual increase is in proportion to the growth of the population. The taxes per individual, however, are decreasing.

The success attained can be judged from the fact that the Parisian does not complain but constantly praises his beautiful, smooth, clean streets, handsome parks, beautiful public buildings, etc. He knows, too, that these things, while pleasing himself, also attract thousands of people from the entire world. These people visit Paris to enjoy its resources and beauty, at the same time spending in the city more money, perhaps, than the vast improvements have cost.

It is well for each city to remember that attractive streets, parks, etc., not only persuade its inhabitants to remain citizens of the place when they become richer and older, but also induce many new people to select such a city for their abode. Above all, it makes life more agreeable for the masses who must live in the place, and acts as a great educator of the children who are to succeed us.

Paris has a simple and safe system of receiving and disbursing its vast income.

Its financial methods, while equaled by the handsome, clean, well-paved modern Berlin, are by no means equaled by London, Vienna, or other large city of the world.

The city treasurer is called the *receveur municipal*. He receives and deposits all money due the city and pays it out upon written orders called mandats, signed by the prefect. The receveur is appointed by the concurrence of the prefect, the secretaries of the interior and treasury of France, and the city council. He is paid one of the highest salaries in Paris, $8,000 a year. He is under

$80,000 bonds. His responsibility is great. He must possess excellent executive ability.

There are three chief inspectors of accounts who, with their assistants, constantly scrutinize all accounts, receipts, etc., of the finance department. We would call them comptrollers. They also watch the book-keeping and every operation of the collection as well as the disbursement of public money. All records are thus assured of being kept in a proper, uniform and permanent manner. They are finally put away in secure vaults for future reference.

MAJOR J. W. HOWARD, B. L., C. E.

See biographical sketch in January number, 1893, page 6.

These inspectors also verify the truthfulness of the statements of the gas, omnibus, horse-car and other companies which pay portions of their profits to the city.

The employes of Paris may have faults, but neglect of duty is not one of their weaknesses. They are noted for honesty and precision, as well as for the courtesy they extend to any one having dealings with them, be he Frenchman or foreigner.

J. W. Howard.

BRICK STREET PAVEMENTS, FROM START TO FINISH.

THERE is perhaps no paving material in existence to-day which gives more general satisfaction for a moderately heavy traffic than a good quality of paving brick. This statement is borne out by the fact that a large number of the smaller cities and towns in various parts of this country have, within the past few years, adopted brick as the standard material for street pavements.

Numerous and extensive plants for the exclusive manufacture of paving brick have been erected at different places, where suitable clay deposits exist, and while the big majority of these plants turn out a serviceable article, it must be admitted that a very inferior quality has been furnished by not a few, owing partly to the inexperience of the manufacturers in this new industry, but mostly to the unsuitable quality of the clay used by them for this purpose, and as the demand for paving brick has so far exceeded the supply, they have been able to find a ready market for their ware, with the result of bringing brick pavements into disrepute whereever the supply has come from these sources.

The writer has in his possession samples of paving brick from a large number of plants, some of which are as hard and tough as the best quality of granite, and which would prove fully as durable, under extremely heavy traffic, while others are not much better than a poor quality of limestone, which goes to show that there is a vast difference in the quality of paving brick. This is not alone, however, the case between the product of different plants, but between bricks burned in the same kiln, owing, in the latter instance, mostly to the unequal distribution of the necessary heat to fuse or vitrify the bricks uniformly.

Will not attempt to discuss the manufacture of paving brick, as that has been and is being done by others, who are experts in this branch of the business, but merely point out the fact, that in order to obtain a first-class pavement, the material must be carefully inspected, to do which, one must know the essential qualities required in a good paving brick, which may be summed up as follows:

Resistance to Abrasion.
Percussion.
Crushing.
Absorption.

To ascertain the resistance to abrasion, some engineers recommend placing samples, together with a lot of irregular pieces of cast-iron, in a foundry rattler, making from 40 to 60 revolutions per minute, and noting the loss in weight, by weighing the samples before and after the operation. This test, while determining to some extent, the toughness of a brick, is not applicable here, since the brick in the rattler is exposed to wear on all sides, while in the pavement only on one; hence the result of this test is not the same as that of actual wear.

A more satisfactory test can be made by taking a brick and a piece of granite, of which latter the resistance to abrasion is known, and after weighing each sample accurately, rub them together the same as a marble-cutter in polishing granite or marble, weighing them again after the operation and noting the percentage of loss in each sample, when their relative resistance to abrasion can be readily deduced.

Tests for resistance to percussion are best made with a light steel hammer (such as is used by pavers for clipping brick), by striking the brick moderately sharp and repeated blows, producing as near as possible the same effect as the sharp, steel-pointed shoes of a trotting horse, which latter will injure a weak brick quicker than a heavy load drawn over it at a moderate gait, since owing to the smooth and even surface of brick pavements, there is no impact or pounding process of the passing wheels, as is the case with granite or other stone block pavements.

Tests for resistance to crushing are usually made with machines designed for the purpose of testing samples of various materials to destruction, noting the weight in pounds, when cracking or spawling begins, and at final crushing, by which means the crushing strength per square inch of surface is ascertained. This test has no further value than to merely establish the relative crushing strength of brick as compared with other materials, since a comparatively soft brick will sustain considerable of a dead load, when placed in the walls of a building, but will crumble and go to pieces, when subjected to the traffic of a street pavement, under a much lighter, but live, or moving load.

The test for resistance to absorption is one of the most important, as no brick will withstand the action of frost successfully (no matter how hard and tough it may be otherwise), which will absorb more than five per cent. of its own weight of water after being immersed from five to fifteen days.

In testing brick for this purpose, the samples should be thoroughly tried, then carefully weighed and immersed in clean water, then taken out and weighed at intervals of from two to five days until no more absorption is noticed.

In addition to the foregoing tests, some engineers advocate tests for tensile strength, resistance to the action of acid, etc., but the writer considers them superfluous, since the position of a brick in a street pavement is entirely different from that of a beam in a structure, and as to the action of acid, it must be a very poor brick that will not bear this test after having passed through the process of burning, unless charged with a large percentage of lime, in which case the absorption test will seal its fate by slacking the lime and causing disintegration.

As previously stated in this article the quality of paving bricks from one and the same plant even, is not sufficiently uniform to depend entirely on tests of samples, especially when it must be conceded that samples are selected with greater care by the manufacturer when sending them to the person who proposes to make the test (unless that person goes to the plant and selects them himself, which, however, is not often the case), than when shipping for actual use. Besides, the facilities for making some of the tests, notably for crushing and tensile strength, are wanting in a large number of the smaller places, and being out of the question of subjecting all or even a small number of the bricks to the various tests, it will be seen that it must depend very materially on the honesty and good judgment of the inspector whether the material employed will prove serviceable or not.

After the average quality of the output of a plant has been sufficiently established by either actual wear in a street pavement, for a number of years, or by thorough and repeated tests of the medium as well as the best specimens, a man of good common sense and sound judgment will have no difficulty in assorting and inspecting paving brick from such a plant in a satisfactory manner, which may be accomplished by adopting the following method:

Have the bricks dumped or thrown from the wagon, when delivered at the line of work. Throw out all such that will not stand this handling successfully. Then after a portion of the pavement has been laid, but before the surface has been sanded, or grouted as the case may be, go over the same carefully and remove all defective bricks, take up and apply the hammer test, as noted heretofore, on such specimens as may appear somewhat soft, by reason of their pale color, which is the case when not sufficiently burned, or those which are very dark, but likely to be porous on account of being overburned, and if they stand this test immerse them in water and observe if small air bubbles appear on the surface in quick succession, or a material change of color takes place, by reason of the large percentage of water absorbed, in which case throw them out, as they will not resist the action of frost successfully.

In addition to a thorough and close inspection it will be good policy to exact a sufficient guaranty from the contractor, for a period of not less than one year from date of completion of his contract, to replace, at his expense, any defective material which may have escaped detection before, and in this way secure a satisfactory job at the original contract price.

After having secured a good quality of paving brick the next question to be considered is how to construct a suitable foundation, as no pavement, no matter how excellent the material of its wearing surface may be, will prove serviceable or satisfactory unless supported by a solid, unyielding foundation.

The first step to be taken in this direction is to ascertain the condition and nature of the subsoil. Should it be spongy or liable to become saturated with and retain more or less ground water, underdrainage must be resorted to, which may be accomplished in the following manner: Lay ordinary drain tile of sufficient capacity, in no case less than three inches internal diameter, about one foot below the base line of the foundation and from six to nine inches back of the curb, towards the property line; fill over the tiling to a depth of about nine inches, with screened gravel or clean cinders, to prevent filling and stopping up the joints and eventually the drain with fine sand or other small particles, and provide a suitable outlet by connecting with a catch-basin at a convenient street corner, or, if this can not be done, by constructing a receptacle which should be bailed or pumped out when occasion requires, or if the topography of the ground permits, by discharging into the open air, in which case a suitable screen should protect the outlet, to prevent rats or other vermin from entering it and destroying its usefulness.

When one side of a street is lower than the other, and the ground adjoining the lower side continues to descend rapidly, no underdrainage will be necessary on that side, as a well-constructed brick pavement will let no appreciable amount of moisture through to the subsoil, after the joints are once thoroughly filled with fine sand, while the drain on the upper side will prevent any water from entering below the pavement there. For this reason, also, it is preferable to lay the drain back instead of in front of the curb and under the gutter, as is done in most cases with macadam, telford or stone block pavements, which, by reason of their porosity, let a large amount of surface water through; besides, the gravel or cinder filling over the tiling, which is to act as a filter, would have to be rammed solid (and thereby decrease its efficiency) when placed under the pavement, while if placed back of the curb it can be left more porous, and consequently will serve its purpose better. Should the subsoil be porous, or cellar excavation exist on each side of the street, which is mostly the case in the business portion of a city, no subsoil drainage will be necessary, as no material amount of moisture can accumulate under the pavement, and therefore the provision for such drainage would prove a useless expense.

Having decided the question of under-drainage, the next thing to be considered is the preparation of the road-bed, on which the foundation is to rest. The subsoil should be excavated to a depth of not less than one foot below the top level of the finished pavement (unless said subsoil should consist of sand, gravel or rock, in which case a depth of from seven to eight inches would be sufficient), and then thoroughly and repeatedly rolled (with a roller weighing not less than one ton per lineal foot of face of roller). All depressions which may then appear should be filled with sand, gravel, cinders or macadam, and the rolling continued until every portion of the road-bed becomes uniformly compact and firm, with its contour corresponding precisely to that of the finished pavement.

Following the preparation of the road-bed comes the construction of the foundation, which should be solid and unyielding, for reasons stated heretofore; and to secure these conditions, various methods and different materials are employed, of which I will cite the following, and endeavor to point out their merits and defects:

Concrete Foundation.—This foundation usually consists of a layer of concrete about six inches thick (the composition of which and the method of preparing it I will not here discuss, as this has been done in a number of published works, and no doubt every one connected with the engineering profession is sufficiently informed on this subject), and when properly constructed has no superior, as regards sustaining heavy loads; but the frequent tearing up of streets, caused by making repairs of, and connections with, the various underground systems, such as sewers, gas, water and steam-heating mains, in all seasons of the year, when it is often next to impossible to replace it to its former conditions (were the average plumbers' forces willed to do so, which they usually are not), and thereby greatly destroying its efficiency. Besides, the danger of leaks in water, steam, and especially in gas mains, remaining undetected until a weak spot in some foundation wall tells the tale, but does not locate the leak, when it may become necessary to sink a number of test pits before the right spot is reached.

These objections apply with equal force to such pavements as asphalt and all others in which the joints are filled with various ingredients for the purpose of making them impervious. The only way of overcoming this serious obstacle is by placing the various underground systems in conduits of such dimensions as will admit of being entered through man-holes by workmen to make any necessary repairs without tearing up the pavement.

From the foregoing it will be seen that so long as these conditions are not the exception, but the rule, in nearly every American city, it may not prove the wisest policy to adopt that which, besides being the most expensive is really good and unobjectionable only under certain conditions, when something else less costly will answer the purpose fairly well, under all conditions.

Broken Stone and Sand Foundation.—On the road-bed (prepared as described heretofore), a layer of broken stone whose longest diameter shall not exceed two and one-half inches shall be spread over the entire surface to an even depth of about four inches and all voids filled with sand, then thoroughly rolled, until uniformly compact and solid, after which another layer of the same material and depth shall be placed on the first and rolled as before, making the combined depth of the two layers seven inches after the rolling is completed.

Broken Stone and Sand, Gravel, Furnace Slack or Cinder Foundation, with one layer of brick laid flat and lengthwise with the street.—This foundation is constructed in a similar manner as the preceding one with this difference that the material constituting the bottom layer, be it stone or sand, gravel, furnace slack or cinders, shall be spread in an even layer to insure a depth of four inches after being thoroughly rolled, then a layer of sand one inch in depth is spread over it and scraped with templets (which are hollowed out on the under edge to correspond precisely with the contour of the finished pavement), upon which a course of brick is laid flat and lengthwise with the street, care being taken to break joints the same as when laid in a wall and laid as true to a line as practicable. The surface being then thoroughly rolled with a hand roller weighing about five hundred pounds per lineal foot of face of roller; or, if no roller is available, it may be rammed with a rammer weighing from seventy-five to ninety pounds, brought in contact with an eight-inch plank two inches thick, which should be placed lengthwise or parallel with the rows of bricks and the blows repeated until the rammer rebounds, all broken bricks to be removed and replaced by whole ones pressed securely into place.

The bricks used in this layer do not require to be of as good a quality as those composing the top layer or wearing surface, not being subjected to chipping or wearing but merely to compression, and this in such a modified form, by reason of the layers of sand above and below them, so that a comparatively weak brick will sustain an extremely heavy load without being injured; therefore a brick having an ultimate crushing strength of only three thousand pounds per square inch will prove efficient, and a foundation constructed in the manner and of the material here indicated will give entire satisfaction, as has been practically demonstrated by a large number of cities and towns.

Ordinarily, it is assumed that a foundation of this kind is more expensive than one of broken stone and sand alone, which is true only when the latter material can be procured at home at a nominal cost, and the bricks have to be brought from a distance where the charges for transportation add materially to the cost; but the conditions are entirely different when this order of things is reversed, especially when it is considered that in the first place this class of bricks are generally sold at a reduced cost, and in the second place the manufacturer would have to charge more for the better quality if unable to dispose of the inferior, in order to secure a fair return from his capital invested. Besides, this layer of bricks will insure a more uniform bearing surface than the other unless the same is constructed with the greatest care and under the most rigid inspection.

On the whole, however, it is of little consequence how or of what material street foundations are constructed so long as satisfactory results are obtained, at the least original cost as well as the easiest and cheapest subsequent repairs, and for this reason the material found nearest home should have the preference, if found suitable for this purpose.

Having considered and discussed the various questions relating to the construction of a serviceable street foundation, we will now turn our attention to the finishing of the pavement, which may be done in the following manner :

On the foundation thus prepared spread an even layer of clean sand of uniform quality one inch in depth, raked or scraped with a templet of the required form, as stated heretofore. Upon this layer of sand place the top course of brick edgewise and at right angles with the street, break joints and lay true to the line, the same as specified heretofore for the lower layer. At street intersections place them at an angle of about forty-five degrees with the street in such a manner that the wheels of a passing vehicle will strike them at an angle and thereby distribute the load more uniformly over several bricks instead of throwing it on to one, which would be the case if bricks were laid parallel to the line of travel, causing unequal wear and formation of ruts. After having the bricks in position for a block or a portion of a block, should it be rather long, make a careful inspection, as described heretofore, then roll or ram the surface thoroughly, as the case may be, until every brick is securely settled into place, and after removing such bricks as may have been broken by this operation and replacing them with whole ones, spread a thin layer of fine sand over the entire surface and broom carefully in the joints, which operation is to be repeated several times (if the sand should not be perfectly dry) before the joints are completely filled, after which the street can be thrown open to the traffic.

In some localities the top course of bricks has been, and is perhaps, still laid herring-bone fashion, which, while having no particular advantage (as regards wearing qualities) over a pavement like the one just described, will require better skill and consume more time in its construction, adding to the cost without increasing its efficiency correspondingly. *William Steyh.*

William Steyh was born September 17, 1845, in Kesselbach, Province Oberhessen, Hessen Darmstadt, Germany. He attended the public schools from 1851 to 1859, graduating therefrom at the age of fourteen and, finding employment shortly after with a surveyor, assisted in land surveying and highway construction for the following six years, pursuing studies in geometry, trigonometry, etc., during the winter months, aided by a kind tutor, who for a small consideration employed his spare time instructing young men eager to acquire a professional education, but whose parents did not possess the necessary means to send them to college. From 1865 to 1866 Mr. Steyh assisted in railroad surveys, which work was suspended indefinitely on the declaration of war between Prussia and Austria, and as the prospects for employment in the various branches of surveying and engineering continued rather gloomy, even after peace had been restored, he concluded to bid farewell to the fatherland and go to the land of the free. After landing in New York, in June, 1867, and paying a visit to relatives in Wheeling, West Virginia, he continued the westward journey as far as Burlington, Iowa, where, in the spring of 1868 he found employment on the Burlington & Missouri River railroad in the western part of Iowa and the eastern part of Nebraska. He remained in the employ of this company till the early part of 1870, resigning the position of assistant division engineer on construction to engage in mercantile business at Burlington, Iowa. After a year and a half he returned to engineering, taking charge of the construction of a small water-works plant at the Iowa Hospital for the Insane, at Mt. Pleasant, Iowa, including the laying out of a portion of the grounds belonging to this institution, which work was completed in the latter part of 1872. From 1873 to 1878 he surveyed and had charge of the construction of four street railway lines and engaged in a general practice of surveying and engineering at Burlington, Iowa. From 1878 to 1882 he followed railroad engineering in the employ of the Chicago, Burlington & Quincy, the Burlington & Missouri River, and the Burlington & Western railroad, respectively. From 1882 to 1892, with the exception of 1884, he has been city engineer of Burlington, Iowa.

INSTRUCTIONS TO SEWER INSPECTORS.

Mr. Arthur Lagron, C. E., sends to Paving and Municipal Engineering, the following copy of instructions to sewer inspectors prepared by him :

Grade.—Grade of an even number of feet above the bottom of the sewer will be given to the contractor or his foreman by the city engineer, or his assistant on a stake driven on one side of the ditch, far enough to prevent all possibility of being disturbed, then another stake will be driven on the other side of the ditch and a straight board nailed across, said board to be leveled with a hand level and the center line of the sewer will be marked on it.

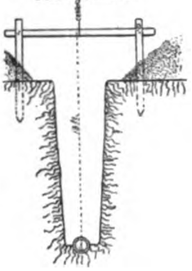
Such grade stakes may be established every fifty feet, but in all cases there shall be one established ahead at the next manhole or lamphole, and all intermediate cross bars shall line to it.

A grade line may be stretched from cross bar to cross bar and supported in the center if the distance be too great to stretch it perfectly straight.

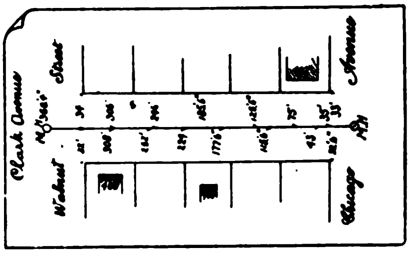
All vertical measurements must be made with a stiff rod, and in no case with a tape.

Although the contractor is by the specifications made responsible for the carrying out of the grade you are to keep a strict and constant watch that it is done accurately and that no changes or alterations are made.

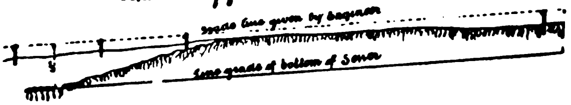
Cross-Section of Ditch
Showing Grade bar



Form of Note Book



Profile showing grade Stakes



Filling.—Permit only fine dry material to be used for back filling next to the joints, and see that it is put in place in a manner that will not disturb the cement. The filling must be well tamped on both sides of the pipe. Do not allow workman to step on the pipes until tamped and filling is sufficient to protect them from being disturbed.

Laying.—See that when practicable, the bottom of the trench is as near as possible made to fit the lower half of the tile, that the body of the tile rests on the solid ground in preference to the socket which should have an excavation specially dug for it. See that the line is kept straight, which can always be ascertained by plumbing from the grade line above.

Joints.—See that each joint is wiped clean of cement before another pipe is laid. See that the socket of the pipe last laid is clean of dirt and gravel, etc., before the bottom is cemented and the spigot inserted, and then see that the pipe is sent well home. Be sure that the cement put on the top reaches far enough on both sides to join with the cement put on the inside and make the joint actually water tight.

Cement.—Cement should in no case be mixed with more than twice its bulk of sand, that is to say one part of cement for two parts of sand. When the bottom of the trench is wet more cement is needed.

Pipes.—All pipes not a true circle must be rejected. Cracks, large blisters, scaling off of the vitrification disqualify pipes. When more than one-fourth of the socket is broken off the pipe must be rejected, and where any part of the socket is broken off, the break must be placed uppermost, and the break made good with brick carefully laid in cement.

Y Branches.—Ascertain from property holders, when possible, where they desire their junction located. Where this can be done, locate them in reference to lot lines where they are most likely to be needed.

Mark each Y with a strip of 1x2 inch plank set in the trench extending from the bottom to the surface, and in filling, see that these strips are cut off (not broken off), flush with the surface.

Carefully measure the distance of each Y from the center of the last manhole, record the distance and the direction in which the Y points, and house number opposite, when any. Also measure the distance from the last Y to the next manhole, so that the Y's may be located by measuring either way from the manholes. Measurements must be from manholes, in no case from Y to Y.

Miscellaneous.—If any extra work is required from the contractor, keep an accurate account of it, or if any timber is ordered to be left in the trench, keep strict detailed measurement of it.

When in doubt, never assume that you know, but refer to the city engineer.

When the work is done, turn your note book over to the city engineer's office.

ELECTRIC LIGHTING AT TOPEKA, KANSAS.*

There are few wants more necessary in a well regulated community than light. After securing a generous supply of pure fresh air, good wholesome water, clean streets and surroundings well drained, we need light by night as well as by day. During the last few years many of our smaller cities, seeing the improvement made in larger places, have secured electric light plants. Some, from a spirit of rivalry, have gone into these enterprises blindly, without counting the cost or carefully considering the questions involved. The strong convincing argument in favor of the arc lamps is the great concentration of light in one lamp. But the light received is as the square of the distance lighted, a fact that is often overlooked.

There are many inquiries constantly being made as to the cost and operation of an established plant. One of the first asked is, does the city own its plant? a question in municipal economy which should receive more attention. That a city should be free to supply its own needs and that of its citizens at cost, without the presence of middlemen to overcharge or discriminate, would seem self-evident.

The next important question is the cost. In reply to such questions, the author has prepared a tabulated statement, taken from the reports of the superintendents which covers the operation of the plant for the last twenty-six months, giving the number of nights and hours run each month and the principal elements of cost, together with the cost of fuel for each horse power for one night and hour.

The plant belongs to the city of Topeka; it was contracted for in February, 1888, and furnished by the Jenney Electric Company, of Indianapolis. There are 184 double carbon arc lamps, 3 boilers 16 feet long, 54 inches in diameter, with 45 flues 4 inches in diameter; 3 Ball engines of 75 horse power with 80 pounds of steam pressure, intended to run 250 revolutions a minute, 6 dynamos of 30 arc lamp power, connected with 6 circuits which together have 24.72 miles of line and 33.5 miles of wire; the line is suspended upon 30-foot cedar poles, and the lamps are suspended at the center of the street intersections between two 40-foot poles. Soon after starting it was found necessary to use more than 80 pounds of steam pressure, and in doing this the capacity of the boilers was found inadequate, except with the best bituminous lump coal. From the tests and experience of a superintendent who was in charge of the plant about one year, it was found that the three engines had to work up to 235 horse power to keep the lamps burning steadily. The exact actual horse power record has not been kept during all this time.

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* Read to the American Society of Civil Engineers.

The accompanying table shows some irregularities. Owing to lack of boiler capacity the plant has to be shut down two nights each month to clean them. This is usually done on moonlight nights, but sometimes it is cloudy and the moon obscured, much to the annoyance of the people. In October, 1891, the plant was shut down for fifteen days to reset the boilers.

The monthly statement of the cost of coal is for coal received and paid for during the month; this comes by the carload, which is ordered as needed, and very little is kept in stock at any time. Owing to the lack of capacity of the boilers, the poor and cheaper coal, such as is used by other electrical plants in the city, can not be burned.

An expert tested some of the lamps without the knowledge of the superintendent and operators, and found as an average of seventeen lamps in different parts of the city a pressure of 23.15 volts, a current of 19.0 amperes, and an electromotive force of 439.85 watts. The manufacturers of electrical plants using arc lamps have fixed an arbitrary standard of their own for candle power. Six of the largest companies allow from 432 to 480 watts for a 2,000 candle lamp; the average of these is 450 watts to the lamp or 4.44 candles to the watt. The author has endeavored to find some reason for these assumptions, but knows of none except that they overrate their lamps for what they can gain by imposing upon their customers. The best authority that he can find on the subject is Gordon Wigan, A. M., whose work was printed in 1884 by Casel & Co., New York, and who makes one watt equivalent to 1.63 candles and cites a test of candle power at the Paris Electrical Exposition of 1881, when the Brush lamp was tested and shown to be 741 candle power. By the American manufacturer's average arbitrary standard the 17 lamps tested averaged 1,953 candle power, allowing 4.44 candles to the watt; but taking Wigan's and the European practice our lamps are only 717 candle power, allowing 1.63 candles to the watt.

This is a great difference, when it is considered that we use the same English standard candles as are used in Europe and elsewhere, for our standard in this country.

COST FROM NOVEMBER, 1889, TO DECEMBER, 1891.

Nights run	672.00
Hours run	5,430.17
Average number of hours run	8.08
Coal consumed, tons	3,587.03
Cost of coal	$9,646.16
Cost of coal per horse power per night	6.11
Cost of coal per horse power per hour	.76
Cost of carbons	2,146.11
Cost of globes	159.05
Cost of oil and waste	504.35
Cost of repairs	3,045.78
Insurance and telephone	905.84
Pay roll, superintendent and labor	13,420.99
Interest on cost of plant, 6 per cent.	7,208.24
Total cost	37,036.52
Average cost per lamp per month	7.74
Average cost per lamp per 100 hours	3.71

PER CENT. OF TOTAL EXPENSE.

Coal	26.04
Carbons	5.79
Globes	0.43
Oil and waste	1.36
Repairs	8.23
Insurance and telephone	2.45
Pay roll	36.24
Interest	19.46
Total	100.00
Cost of lots and buildings	$8,559.33
Cost of plant, poles and wires	46,888.65
Total	$55,447.98

The location of the electric lamps in our city has been a subject of much criticism, with one lamp at every other street intersection; the lamps are about 1,100 feet apart one way and 800 feet the other; the intervening intersections are not well lighted, which is hardly fair to the people living there. With one lamp at every intersection the light would be of much more value, even though the intensity was only one-half of the light of the present lamps.

We have in addition to our electric lamps 222 vapor lamps furnished and lighted by contract at $1.75 per month. These are located in the outlying districts. People complain because they are so insignificant as compared with the arc lamps, and when one compares a vapor lamp of 10 candle power with a 700 candle power lamp, it is not much to be wondered at that some of these districts should complain through their representatives.

The city of Topeka is spending $21,260 a year for lighting its streets, and yet people are not satisfied. About one-half of those inside of the electric light district feel that an injustice has been done them, and all the people outside of this district seem to think they ought to have as good light as the electric lamps furnish, as they are assessed in the same proportion as those who have them.

What we need is a system of lamps at every street intersection, with one circuit covering the business portion of the city on which the lamps shall have an intensity of 1,000 actual candle power.

Then with circuits covering the residence and outlying districts on which the lamps shall have an intensity of 200 candle power. One objection, perhaps, to this would be the large additional number of lamps to clean, adjust and take care of; another would be the long distance for the transmission of the electric current and consequent loss or leakage.

The present arc lamps are good, perhaps perfect in themselves, yet the cost is so great that a city occupying a large territory can not expect to light all and do equal justice to its citizens.

The Edison lamps have not the candle power suitable for street lighting, but it would seem to the author that a system between the two would be more suitable for many of the growing cities in our country.

The cleaning of the arc lamps and globes is a large item of expense and is seldom done perfectly. Fifteen per cent. of light is absorbed by a good clean globe, 70 per cent. by an opal globe, and about the same amount by a dirty globe. The rods of an arc lamp must be kept clean or it will fail to burn, and the cleaner is at once reminded of his duty; but he can allow the globes to become obscured so that from 50 to 70 per cent. of the light is absorbed without any serious complaints from an average citizen. Municipal engineers are largely interested in the question of light. We should try and secure its proper diffusion, that equal justice may be done to all. An engineer should first know what his city needs, and then be able to advise, and prevent a fluent agent of a strong illuminating company from selling an extravagant plant, poorly adapted to the wants of the people. *Louis Kingman.*

MAINTENANCE OF ROADS IN FRANCE.

II.

THE use of material for repair is a necessary operation that can not be dispensed with, yet it does not require a continual attention like the sweeping. In fact, if the road is kept clean, the road-bed wears out uniformly (or very nearly so), and it does not matter much if, for a certain length of time, instead of twelve inches thick it gets to be only ten or eight. The public does not see it; therefore the engineer or the "cantonnier" can choose his time to spread his new stones.

The best time is when the weather is wet, because when it is dry and the road is hard, the new material does not incorporate with it. The stones keep rolling about and get crushed to powder, without any benefit to the road and to the great annoyance of the travelers, while when the weather is damp, with some proper care, it assimilates and gets thoroughly united with the old road-bed without getting scattered about, and is of very little hindrance to the travel, so when frequent rains have softened the road-bed and that frost is not anticipated, then it is the proper time to spread new material on the road.

The principle that must govern the "cantonnier" in performing that work that naturally tends to make the road "pull harder," is to avoid creating any motive that would invite the wagons to follow one direction rather than another, and that is easy where a road has been kept clean. One does not see those long holes or depressions either on the center or on the sides that seem to necessitate extensive refillings; instead, light depressions are seen from one to two inches deep. Those are the places to fill, and as their depth, say two inches in the center, decreases gradualy to nothing on the edges, it is necessary that the "cantonnier" should pick the perimeter in order to give the new filling a solid bearing. Then he carefully spreads his stones on that hole, thus circumscribed, the biggest stone in the center and the smallest toward the edges. Those patches should not be more than from six to ten feet in length and from three to six in width. The same operation is to be repeated for all the little depressions, yet if they were too close together it would hinder the travel to a too great extent. It would then be preferable to fill only the deepest first, and when these would have become solid go over again and fill those that would have been left at first.

When a certain length of road, say 200 feet, has thus been repaired, it would be a grave error to believe that it is finished, and it is an error too often made. On the contrary, the cantonnier must bear in mind that it is the place that requires the closest attention, because those stones are often and continually displaced by the horses' feet, or by the wheels, and unnecessarily crushed, or kept rolling for an indefinite length of time, so he must, every now and then, go over with a rake and replace them.

Also in spite of all his skill in placing his new filling so as to break the wagons from their tendency to follow the same path they sometimes show a preference for one side rather than the other, then he has to do some new filling, or tear up some one already made, until he compels them to go equally all over the road.

It is only when every loose stone has become a part of the solid road-bed, that any portion of the repaired road may be called finished.

It would be a mistake to think that those are minutiæ too small to be taken into consideration. The road will be largely repaid by the economy of material and by avoiding larger repairs that would cost a great deal more than those minute cares do. *Arthur Lagron.*

ARTHUR LAGRON, C. E.
See biographical sketch in January number, 1893, page 17.

ASPHALT OF TRINIDAD.*

It is quite a difficult matter to say what the market price of asphalt is at Trinidad, because it is subject to so many anomalous conditions. The original cost to the government or to owners of the lands prior to the asphalt rage was substantially nothing, and the cost to those who have since purchased lands varies.

In respect to present dealers, very little, if any, pitch is sold in isolated quantities. The usual contract is for the owner or lessee of the land to deliver so much pitch at a certain price annually for a term of years. I should judge that those dealers who have contracted for La Brea land pitch within the last six months have had to pay somewhat more than the lake pitch is sold for to shippers to Europe, to wit, 28*s.* 6*d.*, or $6.84 in local money, free on board.

The following itemized estimate per ton in respect to land asphalt is believed to be a fair approximation:

Price of pitch in the ground	$4 00
Digging, overlooking and cleaning	50
Carting	40
Loading lighters and loading ship	30
Lighterage from shore to ship	50
Contractor's profits, mercantile commission, and all other expenses and losses	1 10
Export duty	1 20
Freight and insurance to New York	2 25
Total	$10 25

When large quantities of asphalt are being handled or other favorable conditions intervene, this total could, of course, be reduced. It is a matter of public record, for instance, that the first cost of the asphalt taken from the pitch lake by the Trinidad Asphalt Company is only 40 cents per ton, and it can be dug more readily than the land asphalt.

I have heard it claimed that all the asphalt at La Brea is substantially one deposit, and that applying the designation of "lake" to only a portion of it is incorrect; but the only part that can be said to be like a lake is alone called the lake by the community.

The village is on an extreme point called La Brea Point; another extreme point to the east is called Point d'Or. The lake is further inland, being southwest of these points and about a mile from them, and about two-thirds of the way from Point d'Or to the opposite side of the peninsula. The lake has an elevation of 138½ feet, according to Wall and Sawkins, above high water, and on three sides the land slopes from it. It is circular in form, and covers, according to a government survey in 1886, 109 acres 9 perches, and it is believed to contain several million tons of asphalt. The geological report of Wall and Sawkins puts the maximum amount which can be expected to exist at 4,752,000 tons. Since this estimate several hundred thousand tons have been removed. The report mentions that the term "inexhaustible," applied to the lake "has probably arisen from the circumstance of artificial cavities rapidly closing up, which may have led to the supposition of the substance being reproduced or generated as fast as removed; but it is essential to remember that every pound abstracted diminishes the remaining quantity by that amount." I believe from the information I have obtained that the contents of the lake have decreased in volume within the last decade, indicating that the "supply," if it has one is not equal to the drainage that is now being made from it.

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* Reports from the Consuls of the United States, No. 145.

Persons who have seen a large round pond, substantially dried up, with little strips of clear water irregularly intersecting its bed, here and there patches of vegetation, and a slushy looking place near the center with fish bubbles coming up, the entire bed blackish and uninviting, can form a very fair idea of the general appearance of this famous lake. An odor described to be like that of sulphureted hydrogen gas is emitted at the sloppy looking place called the "place of supply," where many gaseous bubbles appear. In passing over the lake one will see more or less of these little bubbles, and if he stoops down and catches the odor from them he will find it the same as the odor at "the place of supply" near the center. There are also over the lake more or less little swellings of different shapes and sizes, and I am told that the smaller of them (say an inch square) contain only gas, and that some of the larger ones (say a foot square) contain both gas and decayed vegetation.

There are a large number (say two or three dozen) land islands over the lake which would probably aggregate about three or four acres. They are covered with vegetation, and some of them support trees twenty or thirty feet high; but I am told these islands do not come up from the bottom of the lake nor do they bear down any considerable distance into the lake. Mr. J. W. McCarthy, the local manager of the Trinidad Asphalt Company, informed me that he destroyed one of them and the pitch under it rose to its own level, or the general level of the lake. A horse may be ridden on the lake and up to the "place of supply," and, under particularly favorable conditions, I am inclined to think he might be ridden through it. It is difficult to give a very satisfactory description of this particular spot, and no two descriptions of it can be exactly alike, for it is never identically the same on any two occasions. In an open space, say fifty acres or more, in which there is no vegetation whatever, may be seen a zigzag, irregularly outlined spot, which undergoes constant change in shape and size (when I was there last and took a good look at it, it was bow-shaped and approximated an acre in size). It differs from the surrounding pitch in outward appearance, as freshly molded or bright lead would differ from lead of a duller and darker hue. All of this fresher looking pitch is softer than the pitch surrounding it; but on some of it, at the more distant edges, one may walk without sinking below the heel of his shoe, and I apprehend from appearances, and was so told, that it is only a matter of time for the outer parts to become indistinguishable from the body of the surrounding pitch. Within this particular area is located what is called "the place of supply," which is one or more spots where the pitch is always softer and where, in the hotter part of the day, the pitch, or rather the water surrounding the pitch, fairly boils. These soft parts constantly shift their position, and their fomentations undergo great change, seemingly regulated by the heat of the sun. I am assured by witnesses, whose word I can not call in question, that they have seen the "place of supply" when a person could not have walked into it, both on account of the intense heat and the probability of being engulfed. I have never seen it present so terrible an aspect. On one afternoon, when it was probably in about its usual state, in the hottest part of the day, I saw a man walk into it with impunity, and it only came up to the calves of his legs. He picked up a handful of the pitch and handed it to me. It was as pliable as soft putty, and I manipulated it without any of it sticking to my hands; but the water which oozed from it somewhat discolored my hands, and I was told that if I had continued the manipulation longer, till all the water oozed out, the pitch would have become sticky. Early one morning (eight or nine o'clock) I visited the "place of supply," and the man I had with me walked all over the softest spot without sinking deeper than his foot. At that time two carts containing barrels were being loaded with the "liquid pitch," and the process was to dig and pull it up with picks in lumps, which were put by hand into the barrels. I was told that in the hot part of the day the pick was dispensed with and the shovel used instead.

One of the cartmen pointed to a particular place, a foot or two square, where he said he had been digging that morning and which had filled up. The man with me stepped into this place and gradually sank nearly to his knees, but sank no further. I also noticed that this pitch, unlike that on the previous occasion referred to, stuck with considerable tenacity to the man's legs.

The little channels of water referred to constitute quite a relief to the view. These are quite clear and pretty. They vary in width; but, unless unduly swollen by rainy weather, they may be roughly estimated at two to six feet wide and, say, one foot to two feet deep, though in places the water is much wider and deeper. By these deposits of rain water the lake is divided into a great many irregular divisions. Several persons told me that it was their understanding that these little channels rose and fell with the tide, which seems unreasonable; but, as the opinion is entertained by some of the residents of the neighborhood, I submit it. The pitch comes boldly up to the water, but rarely, if ever, slopes gradually into it, but at the water's edge it is inclined to curve down abruptly, and under the water it does not promptly adhere to the pitch on the adjoining area.

It is understood that the pitch is in constant motion, and the theory has been advanced that each of these irregular divisions has a motion of its own. It would seem, from the appearances, that the water at the outer part of the pitch of the adjoining division has a very repelling effect on the advancing pitch, or else these several divisions of pitch do turn under and revolve respectively within themselves. But evidently the pitch yields in a marked degree to the influences of water. I noticed a little spot of water about six feet wide, which was probably three feet deep—a depression which, if not originally caused by the settlement of water on the spot,is kept in existence by the water. In other words, the pitch would doubtless find its own level were it not for the water. I am strongly inclined to think that the "place of supply" described above, if not the source of supply or generation, is a source of general motion, the degree of motion lessening as it recedes from this center. The fact that there is a large area next around the "place of supply" on which no vegetation grows, and that (in addition to the well-defined land islands) more or less vegetation is found as you approach the border, seems to indicate that the motion near the "place of supply" is too great for sufficient earth to accumulate on the surface to support vegetation.

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As to what percentage of the entire shipments was land pitch and what percentage was lake pitch from 1851 to the present time it is impossible to tell. The facts justify the belief that prior to about 1860 nearly, if not quite, all of the pitch shipped was taken from the pitch banks at La Brea Point; but from about that time to the present the lake has furnished the bulk of the shipments. Mr. Douglas, though evidently a party to the arrangement perfected by Mr. Barber in the winter of 1879–'80, continued to work Point d'Or till June or July, 1882; and I think it quite likely, from the information I have obtained, that the Point d'Or pitch he had collected was not all shipped away before August, 1883, unless he shipped land pitch in this interim from La Cocagne, where it is alleged he continued to dig after he stopped digging at Point d'Or. But this does not exactly agree with the warden's officers' report hereinafter mentioned.

Prior to the arrangement perfected by Mr. Barber in the winter of 1879–'80, pitch was dug at a plantation called Bellevue, by the West India Shipping Company, but I am not informed as to how long a time (if any) that company continued digging there after that arrangement. I notice from the *London Shipping Gazette* and Lloyd's List of April 22, 1892, that one of the stipulations in the sale of that property by a Mr. Callender, on behalf of the West India Shipping Company, was that he (Callender) was not to ship pitch to the United States. The numerous shipments of Mr. Douglas of Point d'Or pitch, on the other hand, from 1879 to 1882, inclusive (I did not have the harbor master's record examined for any other years), were almost exclusively to Washington, D. C.

It is proper that I should observe here that Mr. Douglas, in petitioning against an increase of the export tax in September, 1885, would seem to convey the idea by the language he used, that he had shipped 19,400 tons of asphalt from Point d'Or in the three years from 1882 to 1884. But the evidence seems conclusive that none of the pitch he shipped was dug from Point d'Or after June or July, 1882.

He was charged with obtaining pitch from the lake, which was alleged to be against the special regulations referred to, and the charge was sustained. A letter from the assistant warden (R. Johnstone), at La Brea, dated March 16, 1886, and addressed to the colonial secretary, gives a statement of an employe of the lessees of the lake, withholding his name for prudential reasons, as follows:

"Since Mr. Douglas stopped digging at Point d'Or all the asphalt he has exported has been taken from the pitch lake."

The assistant warden adds to this his own statement, as follows:

"Having had charge of that district for five years, I am in a position to bear out his statement as regards the ceasing of the digging of pitch on Point d'Or; but, being uncertain as to the year when the digging ceased, I thought it necessary to visit La Brea and gather information from those who were connected with Mr. Douglas when he carried on his business himself. With this view in mind I visited La Brea on Saturday the 13th, and ascertained that they ceased working at Point d'Or some time between June and July, 1882. This information I got from men who worked for Mr. Douglas up to the last."

It appears from one of the statements of Mr. Barber that he began using Trinidad pitch soon after July, 1878, and that he first purchased supplies from Mr. E. Burgess Warren, who had bought the same from the agents of Mr. Finlayson. I will add that Mr. Finlayson, so far as I am advised, was at that time dealing exclusively in lake pitch. Mr. Barber's statement also shows that in the spring of

1879 he bought from Mr. Douglas a cargo of *épurée* (boiled pitch). He also entered into a contract with Mr. Douglas to furnish him and his associates with pitch for a term of five years, with the option of renewing the contract twice for similar periods, being the entire term of Douglas's lease of Point d'Or. In the spring of 1879 Mr. Barber and his associates, as he states further, took a public letting at Washington city for 104,000 square yards of work "at the lowest price named by several competitors," which they completed. These circumstances, therefore, would strongly indicate that this work was done with land asphalt, as Douglas, up to that time, is believed to have shipped none other.

I think it can be stated with substantial accuracy that very little, if any, land asphalt was shipped to the United States from about August, 1883, to 1888. From 1888 to 1891, inclusive, Messrs. Thomas A. Finlayson & Co. have kept an account, and have kindly furnished me with the following figures :

TABLE SHOWING THE SHIPMENTS OF LAND ASPHALT.

Year.	United States.		Other Places.	
	Crude.	Épurée.	Crude.	Épurée.
	Tons.	*Tons.*	*Tons.*	*Tons.*
1888	5,620	1,905	600	1
1889	11,327	2,042	....	....
1890	16,460	880	....	....
1891	10,450	....	127	....

The custom-house table of revenue receipts on asphalt will show (considering that the royalty, which is paid on lake asphalt exclusively, is 1*s* 8*d* per ton) that the shipments during the March quarters of 1891 and 1892 were as follows :

March quarters—	Land asphalt.	Lake asphalt.
	Tons.	*Tons.*
1891	4,050	23,454
1892	10,223	23,763

In collecting data for the preparation of this report I came across a published statement from Mr. John Cumming to the effect that land asphalt from Point d'Or and Bellevue was considered very inferior to the pure lake asphalt; and I also came across another statement from Mr. Thomas A. Finlayson, now deceased, as follows:

"The crown lands in the vicinity of the pitch lake have large deposits of pitch easily obtainable and equal in quality to the lake pitch."

These two statements are particularly interesting, inasmuch as the highly respectable firm of A. Cumming & Co., of which Mr. John Cumming is the senior partner, is now engaged as the trusted agent of Messrs. Carter, Hawley & Co., of New York, in upholding the merits of the land asphalt, while the equally reputable firm of Thomas A. Finlayson & Co. (of which Mr. Thomas A. Finlayson at the time was senior partner) is the trusted agent of the Trinidad Asphalt Company, which is in active competition against the land asphalt. * * *

I have given all the foregoing details, as this report is intended chiefly for the consideration of the various city authorities in the United States who are now considering the relative merits of lake and land asphalt in connection with the letting of contracts for making streets. With this important matter in view, I thought it best to give too much information rather than too little.

I have tried to collect all the material facts and if I have failed it has not been because I have failed to consult both sides to an active commercial controversy.

Had the department not called on me to make this report, I should probably not have undertaken to do so, for the reason, if no other, that several gentlemen of fine capabilities, some in the interest of the lake asphalt and some in the interest of land asphalt and some, probably unbiased either way, have been here from the United States investigating the subject. *W. P. Pierce, Consul.*

CURRENT INFORMATION.

MUNICIPAL ENGINEERING NEWS FROM THE NATIONAL CAPITAL.

There is probably no city in the United States where the subject of municipal engineering and city improvements generally, are attracting more interested attention than in Washington. Hardly a week passes by, but that some new question along this line is brought forward to be generally discussed on the part of the citizens.

REMOVAL OF SNOW AND ICE FROM SIDEWALKS.

The subject just now engrossing attention here is the matter of removal of snow and ice from sidewalks and gutters. Last winter being a particularly severe one in this city, resulting in considerable snow and ice, the accidents to pedestrians from slipping upon snow and ice allowed to remain too long on the sidewalks occasioned much comment and complaint in the city papers. One of the victims of the slick sidewalk was Senator Hansbrough, who forthwith proceeded to the senate and introduced a bill which was intended to forever put a stop to simliar accidents. This bill was not reached, or rather no action was taken upon it, during the last session of congress. It has now come up for action in the present session and it is possible that something will be done with it.

During the past week Colonel Ernst has forwarded through Senator Casey and Assistant Secretary of War Grant, his report on this bill. He suggests that with an amendment making the provisions of the bill refer to "paved" sidewalks the first three sections would seem to be in the interest of good government. The section requiring the district commissioners to keep the cross-walks and gutters clear is changed so that the cross-walks shall be cleared to a width of ten feet, and when covered with ice, sprinkled with sand, sawdust or such material as will insure safety to pedestrians. The duties of the government regarding the care of sidewalks about public buildings and through public squares and parks are amended so that the work of cleaning the snow away is to begin after and not upon the commencement of a storm. Only such walks in parks as are thoroughfares shall be cleaned to a width sufficient to accommodate the public, and this is to be done only when funds are available. The communication closes: "It may be proper to remark in this connection that the appropriations for the removal of snow and ice have habitually been less by 20 per cent. than the estimates submitted by this office."

The recommendations submitted by Colonel Ernst are endorsed both by General Casey and Assistant Secretary of War Grant.

A DEMAND FOR BETTER SEWERAGE.

Another municipal question that during the next few months will command much attention here will be the demand for better sewerage. Several times recently communications have appeared in the city papers in reference to this subject, and additional interest has been shown by the protests of the most prominent physicians of the city in regard to this matter, and which appeared in an evening paper over their own signatures.

It is a generally accepted fact that grave defects exist in the Washington sewerage system, and some radical and positive measures are demanded to remedy a condition that no other community in the country would be likely to allow for an instant. The physicians whose letter was above referred to, are unanimously of the opinion that Washington is in danger of cholera with this city's present frightful sewerage and drainage defects.

Plan after plan for proper sewerage and drainage have been presented, yet nothing has been done, or at least no action taken as yet. The officials are willing to do something, but have no means at their command, as they require the neccessary appropriations from Congress to carry on the work that concerns vitally the National Legislators, as well as the community itself. Some of them are beginning to pause to think of the sanitary conditions of the buildings they occupy or visit, that are now without proper drainage. A prominent physician of this city said a few days ago: "It is folly to think of putting a house in a sanitary condition without proper and certain drainage. The silver mounted fixings in plumbing houses may be compared to the silver mounted coffins, both gilded receptacles of disease and death."

TESTS OF ASPHALTS AND CEMENTS.

The inspector of asphalt and cement has made a very interesting annual report to the District Commissioners of the affairs of his office. During the past year he was sent to the Island of Trinidad, from which nearly, if not all, the asphalt used in the District is obtained. He has continued his laboratory tests, and some new features have been introduced, and careful studies made of the nature and applicability of asphalts and cements.

The Commissioners of the District have accepted the proposal of the Schillinger Paving and Curbing Company to improve 18th street from S street to the boundary.

IMPORTATIONS OF ASPHALT.

The official records of the customs division of the Treasury Department for the month of October, the latest period for which statistics have been completed, reveal some interesting facts pertaining to the imports and exports of crude asphaltum lines, during that month, and through the courtesy of treasury officials, your correspondent is permitted to glean the following facts:

During the month of October there was imported into the United States, free of duty, 9,644 tons of asphaltum, valued at $20,585, which is a considerable increase over the imports of the same month last year, when 2,465 tons were imported, at a valuation amounting to $11,291. The imports for the ten months ending with October, reached 85,473 tons, or $302,105 worth, against 70,101 tons during the corresponding period of 1891, and representing a valuation of $239,891.

There were no re-exports of asphalt in October, but during the ten months ending with that month the shipments amounted to 84 tons, or $2,513 worth. During the same period last year a much larger business was done in re-exporting, there being 398 tons shipped out at a value of $4,530.

IMPORTATIONS OF CEMENT.

The imports of cement upon which a duty was paid, reached in October 129,399,235 pounds, valued at 447,169 against 116,727,669 pounds imported in October, 1891, at a valuation of $422,858. For the ten months ending with October these imports amounted to 831,283,460 pounds, worth $2,881,283, which is not quite up to the imports of the corresponding period of 1891, when 1,001,768,795 pounds were brought into this country at a valuation of $3,704,476.

The re-exports of cement in October amounted to 1,289,125 pounds, worth $4,590, which indicates a considerable growth of business over the outgoing shipments of October last year, when 75,694 pounds were re-exported, at a valuation of only $252. The re-exports for the ten months ending with October are almost double that of the corresponding period in 1891, being 6,334,201 pounds, worth $24,197, against 3,342,730 pounds, valued at $14,372. *Egbert Earle.*

Washington, Jan. 15, 1893.

LEGISLATION REQUIRING BETTER GAS LIGHT.

The congressional appropriation committee has taken an important action in the direction of an improvement in the quality of gas that has been furnished consumers in this city. Serious complaints have been made from time to time, and the matter was referred to the Commissioners of the District, who recommended legislation, which will be incorporated into the appropriation bill as follows:

That for securing a better fulfillment of the intent of the act entitled "An act regulating gas works," approved June 23, 1874, two additional laboratories shall be provided and fitted up by the Washington Gas Light Company, subject to the approval of the Commissioners of the District of Columbia, and shall be furnished with suitable apparatus, to the satisfaction of the said commissioners for inspecting and testing the illuminating gas manufactured and distributed by the said Washington Gas Light Company and the gas meters used for measuring the gas supplied to consumers by the said Washington Gas Light Company. One of the said laboratories shall be located in the northwestern portion of the city of Washington and the other in the southeastern portion of said city, and the cost of providing and fitting up the said laboratories shall be paid for by the said Washington Gas Light Company. And for securing the better fulfillment of the intent of the said act, a laboratory shall be provided and fitted up by the Georgetown Gas Light Company, subject to the approval of the Commissioners of the District of Columbia, and shall be furnished with suitable apparatus, to the satisfaction of the said commissioners for inspecting and testing the illuminating gas manufactured and distributed by the said Georgetown Gas Light Company, and the gas meters used for measuring the gas supplied to consumers by the said Georgetown Gas Light Company; provided, that the cost of providing and fitting up the said laboratory shall be paid by the said Georgetown Gas Light Company, and the said Georgetown Gas Light Company shall be liable for such penalties for departures from the standards of illuminating power and purity of the gas manufactured and distributed by the said company as are prescribed in the first section of the said act entitled "An Act Regulating Gas Works," approved June 23, 1874.

Provided, further, that the provisions and penalties of the act entitled, "An act to authorize the appointment of an inspector of plumbing in the District of Columbia, and for other purposes," approved April 23, 1892, are hereby extended to include the practice of the business of gas fitting in the District of Columbia. Provided further, that the Washington Gas Light Company and the Georgetown Gas Light Company shall, at the beginning of each fiscal year, in proportion to their respective sales of gas for the fiscal year immediately preceding, provide in advance by depositing with the collector of taxes of the District of Columbia, a sum sufficient to pay the salary of an inspector of gas fitting, to be appointed by the Commissioners of the District of Columbia, at $1,000 per annum, and also the necessary expenses of maintaining the service of inspecting and testing illuminating gas and gas meters, as estimated by the Commissioners of the District of Columbia.

Provided further, That the daily inspections prescribed in section 5 of the act entitled, "An act regulating gas works," approved June 23, 1874, shall hereafter be made at any time after 12 o'clock, noon, and before 12 o'clock, midnight, in the discretion of the inspector of gas and meters.

Provided further, That the provisions of sections 7 and 8 of the act entitled, "An act regulating gas works," approved June 23, 1874, shall hereafter apply to all gas meters from which the heads shall have been removed by any gas company in the District of Columbia for the purpose of examining and repairing the same, and no gas meter from which the head shall have been removed shall again be placed in service by any gas company in the District of Columbia without having been duly inspected, approved and sealed, as provided for in said act.

During the recent excessively cold weather complaints concerning the inferior quality of gas have been greater than usual, so much so that the matter has been brought before congress, and Senator McMillan, chairman of the district committee, has been authorized to investigate as to whether there is ground for the complaints which have been made with regard to the price and quality of gas in this city. Mr. Ford, the United States inspector of gas here expresses the opinion that a better quality of gas is now being furnished than was the case some time ago. He said that the gas company in this city had recently completed putting in an improved process for making water gas, which he thought had resulted in a better article. In his opinion the difficulty which caused the complaints arose from the condensations in the pipe stopping them up, and preventing the free flow of gas. He suggested to the engineer of the company that perhaps the proportion of the mixture of coal gas with water gas was too great, and that the supply might be enriched by using more of the water gas. The proportion observed by the company was two-thirds coal gas and one-third water gas.

Not only has there been much complaint regarding the quality of gas in Washington, but there has been much vigorous remonstrance against the price being paid here, and the end is not yet.

A. I. P.

Washington, Jan. 17.

RAPID TRANSIT IN NEW YORK.

The recent attempt to sell at public auction the franchise for rapid transit under Broadway and other streets in New York for a period of 999 years, as laid out by the Board of Rapid Transit Railroad Commissioners, was a failure. There was but one bid of $1,000.

That the careful work of five conscientious business men for many months, under the advice of the ablest engineers of modern times, and in a direction which the logic of the times has demonstrated to be imperative, should come to this most ignominious end has been deplored by all, but that the commission itself, certain of its ground from an engineering standpoint, should consider the project a failure, and its own work impracticable, seems almost inexplicable. If the engineering questions had been satisfactorily settled, as is maintained, the fault must lie with the terms of sale. These the commissioners reserved the right to modify as expressly stated in section 17, which reads: "The Board of Rapid Transit Railroad Commissioners reserves to itself the right to reject all bids and readvertise the said rights, privileges and franchises for sale under the same or *different* terms of sale, as often as it may deem necessary in the interest of the city of New York," etc.

After the result of the terms of sale had been realized a meeting of those vitally interested in rapid transit was held at the Real Estate Exchange to devise ways and means out of the dilemma. This was on January 5. A set of resolutions was then declared passed in favor of asking the city to build the underground road herself. But there was a large number who dissented from these views, and who claimed that they had been counted out by the chairman. These, immediately upon adjournment, called another meeting on the spot. Excitement grew apace and crimination followed crimination. Finally upon order being measurably restored, a sub-committee was appointed by the dissenters to draw up and present to the commissioners a set of resolutions adverse to the municipal scheme, and favoring the extension of the present elevated railroad system.

These two committees appeared in open meeting before the commissioners, each claiming to represent fairly the real estate interests, and each denying that the other did so represent them. One faction argued that the city should undertake the underground system, and the other that the plan should be abandoned as impracticable and and that the elevated system should be extended. But no action has yet been taken.

Some of the daily papers and many of the public look upon the whole thing as a fight between two interests, viz: Tammany and the Manhattan Railway Company, and some are so uncharitable as to state their belief that the terms of sale were purposely made prohibitive with the view of advancing either one or the other interest, and that it was never the intention that private capital should take hold of the enterprise. *A. I. C.*

FLOOD WAVES IN SEWERS.

At the meeting on January 4th, of the American Society of Civil Engineers, a paper by A. J. Grover, on "Flood Waves in Sewers, and their Automatic Measurement," was read by the Secretary.

The experiments were made at Omaha, Nebraska, and the rainfall was also recorded. The rain gage employed was a modification of that of the United States Weather Bureau. There were two tops 0.8 inch diameter, the water from one being carried to a cylinder in which it was measured directly by a stick gage, and the water from the other going to an apparatus by means of which a continuous record was made automatically. The sewer gage consisted of a galvanized iron boat 3 feet long, 1 foot wide and 6 inches deep, held in place near a manhole, but with entire freedom to rise and fall. This carried a longitudinal shaft on which at the stern of the boat was a screw 18 inches diameter. The flow of the sewage caused this to revolve, and, by means of gearing, the motion was transmitted to an electric key and recorded. The rise and fall of the boat was also recorded. A storm shield was employed to prevent damage to the apparatus in case of an excessive flood.

The gage was fixed in an 8½ foot circular sewer, which drained 2,100 acres. The longest dimension of this area was 11,000 feet, and the slopes varied from less than 1 per cent. to 18 per cent. The sewers were not well proportioned for the work to be done, and at the junction of the two mains there was a constant flooding. About 150 feet below the gage the sewer was changed in form to a semi-elliptic invert, 16x5 feet, covered with steel beams. The grade at, and for 418 feet above the gage is .0057 to 1. There were 40,000 people in the district, which at 100 gallons per head would make 53.333 cubic feet per day, to which springs along the line added somewhat. Two large breweries, a number of factotories, etc., discharged into the sewer.

With a rainfall of 0.77 inches, 0.3 of which came in ten minutes, the summit of the flood was reached in eleven minutes after the dash was over. With a rainfall of 0.2 inches falling steadily for thirty minutes on the 2.100 acres, the summit of the wave will be at the mouth of the sewer when the rain ceases. In a subsequent rain coming in three dashes, as many distinct fluctuations where shown in the sewer, following quickly the successive falls of rain. A daily normal flow-sheet shows the relative daily velocity of the sewage and illustrates the regularity and precision of the gage, the noon stop of factories and elevators, and the greater use of water on Saturday, Monday and Tuesday.

STREET RAILWAY STATISTICS.

Statistics compiled by the *Street Railway Journal* show that the mileage of electric railways exceeds that of all other street railways combined, although only a little over one-third the cars operated are credited to electric roads. This may be in part due to the reporting of cars used as trailers on electric and cable lines under the head of horse cars; but it is also largely due to the great number of horse cars still running in the cities of New York, Philadelphia and Chicago.

The enormous increase in electric railways in 1892, amounting to 1,878 miles of railway and 4,523 cars, is of course the most striking fact shown by the table. The construction of electric street roads is seen to be nearly half as great in mileage as the construction of extensions to steam railways. Considering the investment in central stations and electric plant and the comparatively cheap work done on many of the steam railway extensions, it is probable that the investment in electric railway extensions has not been far inferior to that in steam railway extensions during the past year. Horse railways are showing a great falling off, in both mileage and cars, and the few steam tramways or "dummy lines" are, on the whole, decreasing. Cable lines increased fifty-two miles.

The total number of cars in use on street railway lines has reached the large figure of 38,400, which is nearly 15,000 in excess of the number of passenger cars in steam railway service. Comparing the two systems of transportation by the relation between cars and mileage, the street railways have 331 cars per one hundred miles of line, while the steam railways have only 17.

DATA REGARDING A MISSISSIPPI RIVER BRIDGE.

The annual election of the Civil Engineers' Society, of St. Paul, on January 9, resulted as follows: President, George L. Wilson; vice-president, J. D. E. Stabrook; secretary, C. L. Annan; treasurer, A. O. Powell; librarian, A. Munster; representative on the board of managers of the Association of Engineering Societies, C. J. A. Morris. The president-elect made the following appointments for the ensuing year: Examining board: C. F. Loweth, A. O. Powell and E. E. Woodman; auditor of accounts of 1892, W. C. Merryman.

Mr. Joseph S. Sewall, Member American Society Civil Engineers, designer and engineer in charge of construction of the bridge over the Mississippi river, connecting Marshall avenue, in St. Paul, with Lake street, in Minneapolis, informally presented some interesting data concerning that structure. The bridge consists of two principal iron-arch spans of 456 feet each, and its total length is 1,273 feet. A twenty-foot roadway is laid on 7x16 wooden stringers and is designed to admit the passage of a fifteen-ton road roller. There is a five-foot sidewalk on either side. The appropriation was limited to $150,000, and was to cover all preliminaries. The cost of the sub-structure, abutments resting on sand rock and pier on gravel, was $32,360; superstructure $109,100. Portland cement was used in freezing weather only. Work was begun in October 1887, and finished in May 1889, considerable delay being caused by non-arrival of material.

C. L. Annan, Secretary.

NATIONAL MEETING OF BRICK MANUFACTURERS.

The annual meeting of the National Brick Manufacturers' Association at Louisville, beginning on January 24th, was largely attended. Following the annual address of President Pearson, reports were submitted by the Secretary and Treasurer. Following the prececedent of electing as President a representative of the city in which the convention was held, Mr. A.L. McDonald was put in nomination. With a view to breaking the line of precedent he declined the nomination and proposed Anthony Ittner, of St. Louis, who was elected. The other officers elected were First

Vice-President, A. L. McDonald, Louisville; Second Vice-President, W. P. Gates, Chicago; Third Vice-President, B.W. Blair, Cincinnati; Recording Secretary, C. P. Merwin, North Haven, Conn.; Corresponding Secretary, T. A. Randall, Indianapolis; Treasurer, John W. Sibley, Alabama. Wednesday night the annual banquet was given at the Galt House, with J. P. McCullum as master of ceremonies. Brief addresses were made by Messrs.Ittner, Gates,McDonald, Purington, Adams, Blaffar, Alty, Merriweather, Pinger, Eudaly and others. At the sessions on Wednesday and Thursday, the programme of papers as outlined was carried out,among the features being an address on "Vitrified Brick," by Capt W. S. Williams, of Canton, O., which will be published in PAVING AND MUNICIPAL ENGINEERING hereafter, a paper on "The Manufacture of Brick from Shale by the Dry Press Process," by J. R. Figh, of Dallas, Tex., and "The Evolution of the Brick Machine," by Cyrus Chambers, of Philadelphia.

SOME RECENT INVENTIONS.

A Paving Brick, by L. C. Turley, Portsmouth, Ohio, is of a rectangular shape with a plain top, bottom and ends, and has a longitudinal recess in its face and a corresponding interlocking rib on the other, with a series of welts in relief on one of said faces.

A Portable Bridge, by Lewis Barnes, assignor to William A. Nichols, Wayne, Pa., which is intended for ditches at or beneath the surface of the ground. The chief novel feature is in the attachment to the ends of the bridges of wings formed of sills, stringers and brace pieces. The object of the wings on each side at the end of the bridge seems to be to prevent the ground at that point from being washed away.

A Pipe Coupling, by William R. England, Chicago, Ill., consists of one member being provided with a longitudinally - corrugated spigot and another member having an interiorly - longitudinally - corrugated bell, the corrugated portions of the spigot and bell interfitting with each other, and about them is an angular chamber for packing.

A Machine for Making and Repairing Roads, by Martin G. Bunnell, assignor to Frederick C. Austin, Chicago, Ill., consists of a four-wheeled carriage with the front and rear wheels far apart and a frame between supporting a scraper adjustably. The frame is adjusted vertically or laterally by a lever, the rear wheels are shifted laterally by the use of a hand wheel and chain, and the vertical angle of the scraper is adjusted by the use of another hand wheel. Two men are required to operate it, one to drive and one to guide and adjust the machine.

A Street Crossing, by George W. Doolittle, Chicago, Ill., consisting of a U-shaped trough extending across a street, with metal plates resting on the upper edges of said trough level with the street and having a closely arranged series of serpentine ribs provided with edge notches and grooves between the ribs having their bottoms inclined in opposite directions to the transverse openings through which any water may pass.

A Bridge Gate, by Eugene Delia, Chicago, Ill., consisting of the combination with the bridge approach or abutment of an extensible gate secured at one end to a fixed post of the abutment and at its other end having a latch and traveling on a caster or a wheel, whereby the gate closes automatically and is provided with the usual means of opening the gate.

A Pavement, by Benjamin F. Spry, Des Moines, Ia., is composed of pieces or strips with grooves in their side faces and separately set on edge on a road bed so as to extend transversely across the road and parallel to each other, and solid blocks corresponding in length with the width of the said parallel pieces, and having ribs on their side faces adapted to enter the grooves in the cross pieces. After thus formed a composite filling material is put in the vacant spaces between the blocks and cross pieces. These cross pieces may, if desired, extend diagonally from the side to the middle of the street.

An Artificial Stone, by Hermann Endemann, assignor to the American Carbonate Company, N. Y., consisting of magnesia, magnesia hydrate, and basic oxalate of magnesia and sand. It is prepared by mixing magnesia, oxalic acid and water, and after allowing the mass to harden, to expose the same to the action of an oxalate.

A Wheeled Excavator aed Carrier, by Marcus E. Cook, Wallingford, Conn., has an arched frame mounted on trucks, a scoop being suspended from such frame by a mechanism which is adjustable and can be so operated by a lever as to hold the scoop in any desired position.

A Border for Walks, by James E. Chapman, of San Jose, Cal., consists of vertical curb sections with exterior and interior vertical corrugations and a base, the bottom of which extends outwardly at right-angles with the vertical portion, the upper surface meeting the outer vertical surface at an angle greater than a right angle, and having corrugations formed therein in continuation with the corrugations in the exterior face of the vertical portion. *V. H. Lockwood,*

Patent Attorney.

Indianapolis.

LEGAL DECISIONS.

Use of Highways for Water Mains—The laying of pipes and hydrants as authorized by the New York law, by a private corporation, in the highways of an unincorporated village, for the purpose of supplying the inhabitants with water, all of the inhabitants being entitled to the use thereof on the payment of a reasonable rate, is for a public use, even though no contract is or could be made with the municipality to supply it with water, and the highways may be so used on obtaining a permit from the village, as provided by the law. The fact that the village is unincorporated, and no contract can be made with it to supply it with water, and that the company cannot, therefore, exercise the right of eminent domain, is immaterial, since the right to so use the highways is not based on the right to condemn property, but on the doctrine applicable to the use of urban highways for such purposes. Such use of the highway does not impose an additional burden on the fee, for which the abutting owners are entitled to compensation. Witcher *v.* Holland Water-Works Co., Supr. Ct. of N. Y., 20 N. Y. Sup. 561.

Liability for Improper Sewer Construction.—Under the California statute providing that the superintendent of streets shall give bonds on which, if he fails to see the laws, ordinances, orders and regulations relative to streets or highways executed, after notice of violation thereof he shall be liable to any one injured in person or property in consequence of his official neglect; and section 11, providing that all persons directly interested in any work provided for in the act, feeling aggrieved by any act or determination of the superintendent relative thereto, shall appeal to the city council, and further providing that all the decisions of the city council shall in certain respects be final; the remedy of one complaining of the superintendent's neglect in not seeing that a sewer was properly constructed in accordance with specifications, is not confined to appeal, and there having been none he can not sue on the bond. Goodsell *v.* Ashworth, Supreme Court of Cal., 31 Pac. Rep. 261.

Specific Enforcement of Filtration Contract by Water Company.—Where a water company, under its contract with a city giving it an exclusive franchise, has established its plant, laid its water pipes in the streets, and private consumers have, at large expense, conducted the water into their houses, a provision of the contract making it the duty of the company to filter the water intended for domestic use, will be especially enforced at the suit of the city, as an action for damages by the private consumers would be wholly inadequate, and a forfeiture of the exclusive franchise of the company would entail on the city the needless expense of erecting new works. The fact that the company, under its contract, has the right to pump unfiltered water through its pipes in case of fire, does not excuse it from its failure to filter the water at other times. The fact that a filter put in by the company was adequate when its works were constructed, does not excuse it from putting in a new one after the old has become inadequate by reason of the city's growth, and the consequent increase in the demand for water. The fact that the city may have delayed in applying taxes raised by it to the payment of the interest and principal of the company's bond, as required by the contract, and that it ordered the company to lay pipes where they were not required, will not defeat its action for specific performance; it appearing that all taxes had eventually been applied as provided for in the contract, and that the city had not insisted on compliance with its order respecting the laying of pipes. City of Burlington *v.* Burlington Water Co. Supr. Ct. of Iowa, 53 N. W. Rep. 246.

Fire Liability Can Not be Contracted Away.—The Iowa statute provides that "any corporation operating a railway shall be liable for damages by fire that is set out or caused by operating such railway"; and another section provides that a common carrier can not exempt itself from liability as such carrier by contract. A contract between the owner and operator of an elevator, coal shed, and corn-cribs, and a railroad company, exempting such company from liability for damages by fire negligently set by its engine, is void, where it appears that such buildings were built and used for the purpose of promoting the business of such railway company. Griswold *v.* Illinois Central Ry. Co. Supr. Ct. of Iowa, 53 N. W. Rep. 294.

Liability for Bridge Breaking Under Threshing Outfit.—In an action against a county for an injury to a team and threshing outfit, caused by the breaking of a bridge while attempting to drive across it, is for the jury to determine whether the use which was being made of the bridge was unusual and extraordinary, and such as the county was not bound to anticipate; and a verdict in favor of the owner will not be disturbed on the ground that such use was improper. It can not be said, as a matter of law, that the use which was being made of the bridge was unusual and extraordinary, and such as the county board was not bound to anticipate. Such machines are in common use, and of necessity are frequently moved along the highways and across the bridges of the county. Their passage is not so frequent as vehicles in more common use, but the same is true of four- and six-horse teams, and yet a court would not declare, as a matter of law, that the passage of such was not to be anticipated. Yordy *v.* Marshall County, Supreme Court of Iowa, 33 N. W. Rep. 208.

Appropriation of Water.—Where a person constructs and maintains a dam in a stream on public lands for the purpose of supplying a canal with water to be used for beneficial purposes, he acquires a possessory interest in the dam, the pond formed by it, and the land under the pond, and others will be enjoined from extending a canal into the pond, even though their intention is to take only the surplus water after the former's canal has taken its supply. Natoma Water & Min. Co. *v.* Hancock, Supreme Court of California, 31 Pac. Rep. 112.

LAYING A WATER-WORKS INTAKE IN LAKE SEBAGO.

A 48-inch cast iron water-works intake was recently laid beneath Lake Sebago, by the Portland, (Me.) Water Company. The pipe was put together on shore, with heavy leaded joints. The two ends of the line of pipe were stopped, and the pipe rolled over sticks into the lake, being checked at four points with wire cables and pulleys. A small tug towed the pipe for two miles to a trench which had been dredged for it in the bed of the lake. The water was quiet but there was more tendency to lateral bending of the line than had been expected, the rigidity of the line depending upon lead joints.

At the outer end of the pipe a T joint was placed. In sinking, the outer end of the pipe reached the bottom in 15 or 18 feet of water, while the 314 feet nearest the shore remained at the surface, thus the outer 136 feet bent to a curve. When the pipe was in this position the shore end lacked about 12 inches of making a junction, but in grounding in the trench the pipe moved to within 4 inches of the pipe in the gate house and a joint was made with a sleeve.

COST OF A COLORADO SEWER.

The cost of a 16-inch vitrified pipe outlet sewer, 7,100 feet long, recently completed by contract at Trinidad, Col., is given by Mr. Norval W. Wall, City Engineer, as follows: The total cost was $11,263.

The price per lineal foot was $1.48, not including extras. The contract price for masonry was $5 per cubic yard; for solid rock excavation, "extra from earth excavation," $2.50 per yard; for nine manholes, $35 each; for twelve inspection pipes, $8 each; for lumber, 2 cents per foot, B. M. The average cut was 6.4 feet.

A siphon of 16 inch cast iron pipe, about 115 feet long, was laid beneath the Las Animas river, in a shallow trench, for $605. The pipe was three-quarters of an inch thick, with ordinary lead joints. At each end of the siphon there was a Trinidad sandstone manhole, laid up in Portland cement mortar, 4 feet square, one 12 1-3 and the other 10 1-3 feet deep, with concrete foundations and bottoms. These manholes cost $507. The cost of the siphon and manholes is not included in the total for the outlet sewer.

GRANITE OF GREAT CRUSHING STRENGTH.

The crushing strength of granite, the strongest of building stones, is commonly rated at 12,000 to 15,000 pounds per square inch, when tested in two-inch cubes, and only the hardest and toughest of the commonly used varieties reach a strength above 20,000 pounds. Recently, however, a granite quarry has been opened on the Connecticut river, the product of which shows a crushing strength averaging some 30,000 pounds, or nearly double that of the average granite in the market. Samples of this stone tested at the Watertown Arsenal have shown a maximum ultimate strength of 35,965 pounds per square inch.

PAVING BRICK IN GLASGOW.

Brick paving is to be tried in Glasgow. It is in common use in some Continental towns, but the difficulty of procuring the right kind of material in England for the manufacture of bricks of a sufficient hardness and toughness has prevented that form of paving being tried. Proper material has, it is said, now been found near Braidwood, and the bricks are to be manufactured by the Omoa Fireclay Co., which is erecting new works for the purpose. While the material is called a clay, it is in reality an imperfect hematite ore, and requires to be quarried.

DURABILITY OF ASPHALT PAVEMENTS.

Some new and interesting facts bearing upon the relative durability of asphalt and granite pavements are given in the full-page advertisement of the Warren-Scharf Asphalt Paving Company, which those who are interested in pavements will do well to read.

PERSONALS.

Mr. A. R. Turner, Jr., chairman of the water board of Malden, Mass., has resigned.

Mr. Chas. D. Colson has been appointed water commissioner of Holyoke, Mass., for three years.

Mr. Harry Goldmark has opened an office in the Rialto Building, Chicago, Ill., for practice as civil engineer.

Prof. R. H. Thurston, of Cornell University, has been appointed a member of the advisory council of engineering and marine architecture at the World's Fair.

Mr. F. A. McClure has been reelected city engineer of Worcester, Mass. Mr. John S. Brady has been elected water commissioner, and Mr. H. B. Eddy superintendent of sewers.

Mr. Charles Hubbard has been reappointed a member of the board of water commissioners of Syracuse, N. Y., for the term of six years. Mr. Wm. B. Cogswell has been appointed for the unexpired term of Mr. Peter B. McLennan, resigned.

Mr. W. Barstow, of the Brooklyn Edison Electric Light Company, has gone to London and Paris to investigate the electric light plants of those cities in the interests of his company.

Mr. H. P. Bradford, who has been manager of the electric street railways in Little Rock, Ark., for a long period, has been appointed manager of the Mt. Auburn electric road in Cincinnati, O.

Mr. Rudolph Hering, of New York, the well known sanitary engineer, has been appointed consulting engineer for the sewerage system of Washington, D. C., and the District of Columbia.

Mr. A. B. Ellsworth, Jun. Am. Soc. C. E., died Jan. 10. He was a member of the firm of Ellsworth Bros., civil engineers and surveyors, Buffalo, N. Y.; was a graduate of the Massachusetts Institute of Technology, and for three years prior to April last was resident engineer for a Pittsburg testing laboratory, at Athens, Pa.

Mr. Thomas Sedgwick, M. Am. Soc. C. E., San Diego, Cal., has been appointed by the mayor to fill the vacancy in the board of water commissioners of that city occasioned by the resignation of Mr. T. Shaw.

The annual meeting of the Connecticut Association of Civil Engineers and Surveyors was held at Hartford, Jan. 10. Officers were elected as follows: President, E. P. Augur; vice-presidents, F. W. La Forge and W. G. Smith; secretary and treasurer, W. B. Palmer; executive committee, E. P. Augur, C. H. Bunce, B. H. Hull and F. W. La Forge.

The Western Society of Engineers, at its annual meeting and banquet, held in Chicago in January, elected the following officers for the coming year: President, Robt. W. Hunt; first vice-president, R. A. Rust; second vice-president, H. B. Herr; secretary and librarian, John W. Weston; treasurer, E. G. Nourse; trustee, Geo. S. Morison.

LETTERS FOR THE PUBLIC.

FOUNDATIONS FOR BRICK STREET PAVEMENTS.

To the Editor of Paving and Municipal Engineering:

SIR—I read with some interest Mr. Whitten s article on "Foundations and Construction of Brick Pavements." I am of the opinion that there can be no set rule for the construction of foundations that will be satisfactory in all localities. I think that every city must decide on what will make the best foundation, from the nature of its sub-soil. A rolled gravel foundation might meet all the desired wants in one place and be a failure in another. I also believe it possible to make a poor foundation out of concrete and a good one out of gravel or stone. It is *not* so much a matter of what a foundation is made of as how it is made. I know that some of the smaller cities in Indiana will be dissatisfied with their brick streets and stone foundations, for the simple reason that they were not made right. A five-ton horse roller is not heavy enough to roll eight inches of crushed stone, and you can not make a solid surface upon crushed stone without covering it with an inch of coarse gravel before rolling. Those who have made these foundations have rolled directly upon the stone and used too fine a sand for making the surface for the brick. As the sand dries it sifts down into the stone, and the pavement follows it, and results in a rough pavement, which could be obviated by the use of a gravel coating, thorough rolling and using coarse sand.

I can not see the merit of laying brick at an angle of forty-five degrees. Even though it saved some in wearing qualities, it makes it much harder for a horse to get firm footing when starting a heavy load, and that is the very reason we lay them at an angle in intersections. It keeps the wagon at right angles with the brick, while making a turn, and insures the horse a firm footing. Another virtue claimed for laying them at right angles with the curb is that the bearing of wheels is distributed over the greatest number of brick, the bearing never being on one or two bricks, but four or five.

Columbus has built a great deal of brick paving, and has done considerable experimenting, and the result is to use one course of brick, well-rolled stone foundation, brick laid at right angle with curb and forty-five degrees at intersections, and tar filling. *F. W. Cerny.*

Columbus, O., Jan. 24, 1893.

AMERICAN ASPHALT PAVING IN PARIS.

To the Editor of Paving and Municipal Engineering:

SIR—In your last issue I find a letter from W. H. Delano, of Paris, replying to my "Classification of Asphalts" in your issue of November last.

I don't wish to say anything more regarding it, as it is impossible to convince those who do not wish to be convinced, and leave the judgment to the intelligent readers of your valuable magazine.

The letter of Professor De Smedt, appearing also in your last issue, is very conclusive in regard to the error of those two gentlemen, Malo and Delano. In regard to other points, I wish to say, "People who live in glass houses should not throw stones."

Mr. Delano may never have seen your correspondent, Louis H. Gibson, but he, Mr. D., took good care that your correspondent received all information, some true and some not true, in order to write some disparaging reports about the American asphalt, and lauding up the French asphalt. Mr. Gibson having no knowledge about asphalt and asphalt streets, reported as informed, and his article, being so extremely unjust to the American company, who laid the asphalt in Paris, I replied to it, because I know all about the laying and breaking up of the pavement in Paris.

I never have denied that I superintended the laying of the American asphalt in Paris. I affirm, I did, and furthermore, I say, the enormous traffic on Rue de Rivoli broke it up.

In the same year, 1886, Mr. Delano laid, with his Seyssel rock asphalt, a piece of Rue de Rivoli, along Hotel de Ville and Place de Hotel de Ville, up to Rue du Renard, abutting American asphalt at Rue Lobau. This piece of Rue de Rivoli was far better located and more suitable for asphalt than the piece the American company laid, which last piece Mr. Delano had refused to lay. Mr. Delano had no tramway to contend with, yet the piece required numerous repairs in the first winter; in fact, during all the time I had the time to examine it, and I believe, had it been laid by a foreign company, it would have been condemned entirely.

Mr. Delano, although he claims to know so much about asphalt, has yet, like myself, a great deal to learn.

The figures of the amount of asphalt laid in the principal cities of Europe, given by Mr. Delano, are certainly exaggerated, and he forgets to mention that his company laid, probably, only one-fifth of the total.

Please correct the misprints in my article, "Classification of Asphalt," on page 153 of last November issue. In the middle of the last column you state "Sivilian" and "Gimmer" instead of "Sicilian" and "Limmer."

Julius Schubert.

New York, Jan. 25, 1893.

SELECTIONS FROM THE PRESS.

ELECTRIC RAILWAY BUILDING.

The past year has seen a great number of the street railways using horse power equipped electrically, so that as matters now stand it would look as though electric railway building during the coming twelve months would be to a large extent in the direction of building and equipping new roads; and, judging from the present indications, many of the new roads, particularly in the more thickly settled portions of the country, will be either suburban or interurban roads, thus giving the actual competition with steam roads that has been threatened.

A feature in connection with the building of electric railways which is worthy of passing mention is that of the company furnishing the apparatus, also furnishing money with which to buy out established lines, consolidate them and increase their earning capacity. The larger electrical companies seem to be doing considerable of this both with railway and light companies. The American Bell Telephone Company inaugurated a similar plan in the early days of establishing telephone exchanges. Afterward it disposed of some of its holdings of such securities, but they developed into such good investments that in many instances it purchased them back again at a decided advance in price. The holdings of many electrical manufacturing companies in light stations and street railways will in the same way very likely prove paying investments.—*Electrical Industries.*

THE TROLLEY AND INSURANCE RATES.

It seems hardly probable that the introduction of the trolley road in an outlying, sparsely settled part of this city should be the cause of a raising of the insurance rates over the whole city of New York, though the announcement that such a raise has been determined upon by the Board of Fire Underwriters followed almost immediately the report that the trolley franchise had been granted. The fire insurance premiums paid in this city amount to over $7,000,000 annually, even only a slight raise of which is no small burden on an already overtaxed community. But as a rise in insurance rates has followed the trolley in Boston, Brooklyn and New York, even though seemingly unjust, companies introducing electric railways will find it greatly to their interest to give their very best attention to making the trolley wire absolutely safe, even at considerable expense, against being crossed. —*Electrical World.*

INCREASED EARNINGS OF RAPID TRANSIT.

So much has been written on what a change from horse to mechanical power will accomplish readers are apt to accept the statement, but neglect to notice in how marked a degree is the resulting increase.

The Binghamton, N. Y., street railway is a good example of the above, and the more so because it is not one of the larger roads. This road shows the following wonderful increase in the past three years: Gross earnings year ending Sept. 30, 1892, $12,163.40; gross earnings year ending Sept. 30, 1892, $52,240.33; gain for July, August and September, 1891, over 1890, $4,621.05; gain for July, August and September, 1892, over 1891, $5,008.14. Showing a total gain of this period of three months of 1892 over 1890 of $9,629.19, the same being a gain of 73 per cent. and with the same track mileage and local conditions.

The earnings shown for year ending Sept. 30, 1892, were made with ten miles of the system operated by electricity; the balance by horse power. The remaining 3½ miles have been electrically equipped by the Binghamton Railroad Company since consolidation, and operation commenced Oct. 13, '92, and with the same number of cars (three) for the first four weeks earned, viz.: Oct. 13 to Nov. 9, '92, electricity (3 cars), $1,264.80; Oct. 13 to Nov. 9, '91, horses (3 cars), $538.55.

Earnings under same conditions and with the same number of cars, for the first two weeks operated by electricity, and last two weeks operated by horses: Oct. 13 to Oct. 26, '92, electricity, $680.30; Sept. 29 to Oct. 13, '92, horses, $322.60.

The growth of the city of course has had somewhat to do with this increase, but does any person imagine for a moment horse car earnings could have made any such showing?—*Street Railway Review.*

THE PHILADELPHIA TROLLEY ROAD.

The recent final decision of the courts, which opens the streets of Philadelphia to the trolley, concerned a legal technicality and not the virtues of the trolley. It is a great triumph for the electrical system, as this project embraces the largest mileage of streets in any one city on which changes from horses to electricity are contemplated in one sweep. With its 500 miles of street railways, Philadelphia heads the lists of cities of the entire world in this feature, being seconded by Chicago. Most of its roads are owned by the company who succeeded in getting the valuable trolley privileges. The change from horses to trolley, it is estimated, will make a difference of millions of dollars every year in the net profits to the company. Some idea of the size of the undertaking may be had from the fact that at least 10,000 poles will be required to equip the lines at present contemplated, and it can hardly be doubted that this change will soon be followed by a similar one in all of the other roads of the city.—*Electrical World.*

NEW YORK CITY'S SEWAGE DISPOSAL.

In the light of modern practice in sanitary engineering, the method followed by New York City in disposing of its sewage is of the crudest kind. For years it has contented itself with simply discharging its waste of all descriptions into the rivers flowing by it, thus depositing thousands and thousands of tons of solid matter annually in its harbor, and promising, it would almost seem, eventually to impair greatly its shipping facilities by accumulations of disease-breeding offal. Fortunately for the health and prosperity of the city, however, the conditions ruling in its surrounding waterways are somewhat unique, the flow of water in the rivers and bay being so regulated by nature that there is a constant and powerful current, tending to disperse whatever solid matter of readily divisible character is discharged into it.

Still, there is little doubt that a gradual process of filling up the harbor of New York is in process, says the *Mechanical News*, and it behooves those responsible for the city's future welfare to keep the problem of rational sewage disposal in mind, with the view of adopting at some time in the near future a disposal system more in accordance with the dictates of common sense than the primitive one now practiced. Discharging sewage into adjoining waterways is the plan which naturally first suggested itself, and which was first followed in trying to get rid of the waste material of any measurably large congregation of people.

It has to commend it, directness and cheapness and reasonable efficiency. With the growth in the number of people to be provided for, however, it presents obvious shortcomings, which have become pretty well recognized all over the civilized world, and, wherever possible, it has been abandoned for some one of the several more scientific methods of disposal which have been brought into use, and which, in scores of places, are giving the most satisfactory results. New York alone, of all the large cities, has strangely lagged behind in the march of progress.

It is not reasonable to expect, however, that it can much longer follow the crude method of river carriage for its sewage. The problem of more rational disposal must be taken in hand at some time—and that not far distant—and it may, therefore, be well said that there is no time better than the present in which to take the initial steps toward its solution.—*Plumbers' Trade Journal.*

THE WILMINGTON, DEL., SEWERAGE SYSTEM.

The sewerage of Wilmington, Del., has furnished problems upon which a number of engineers have reported from time to time, as noted in our past issues. The plan which is now being followed was prepared by T. Chalkley Hatton, the engineer in charge of sewers, and is substantially a union of the combined and separate systems. The city is largely built on a hill, with a flat area of some extent at the foot, the latter being the most densely populated portion. The use of cesspools and privy vaults has resulted in a bad state of affairs in many districts, especially where the poor classes live. An inspection of a small area in the eastern part of the city showed that out of 88 adjacent privy vaults, a like number of cellars and 7 stables, 12 of the vaults were running over, draining into a back alley; all of the stables were in the same condition, and all but eight of the cesspools emitted a decidedly nauseating odor. Water was also standing in four of the cellars to a depth of 2 to 4 inches, and in most of the others, a damp, unpleasant odor was very marked.

The sewerage system, as now designed, comprises 20 divisions, many of which need not be constructed for some time. The most difficult sections to build will be in the low, marshy areas along the rivers bounding the city on two sides, where land lies below mean high tide, with a slope toward the river of about 0.1 per cent. The population of the city is about 62,000 and its area 5,760 acres. If the city increases in the future at its past rate, large districts in its heart at present undeveloped will be built up to the average in other places, so that in the designs for the new system the maximum population has been assumed at 87 persons per acre, about eight times the present average. The size of the separate sewers is designed on the assumption that each person will furnish 100 gallons of liquid wastes in 24 hours, and that one-half of this amount will be furnished in six hours. Under these assumptions the maximum discharge will be about 0.27 cubic foot per second per acre.

In proportioning the storm water and combined sewers the surface run-off has been calculated by the Burkli-Ziegler formula, using a coefficient of 0.4 and assuming a maximum rainfall of 3½ cubic feet per second per acre. A large amount of ground water has to be provided for, the quantity being estimated at 3.6 cubic feet per acre per hour. As a general thing, sewers having a diameter under 18 inches and over 40 inches will be circular in section, while those between such limits will be egg-shaped. The sizes have been determined by the Eytelwein formula, $V = 93.4 \sqrt{r s}$. The depth of the crown of the sewer, below the street level, ranges from 9 feet in the resident portions of the city to 12 feet in the business portions. Manholes will be built if possible at every change of direction or grade and at no greater distance apart than 350 feet. Lampholes will be built at the dead ends of all the small 8-inch pipes. The minimum radius of the curve with which two tangents are connected has been fixed at 20 feet.

The sewers in the hilly portions of the city have some very steep grades and the erosive action of the sewerage is correspondingly great. To resist this action, Mr. Hatton recommends constructing the inverts in such places of salt-glazed, vitrified fire-brick for the smaller sewers, and of granite blocks dressed ¼-inch joints for the larger ones. The intercepting sewers, which it is proposed to carry along the water front of the city, and portions of which are already constructed, are quite flat in places, and two pumping stations will be necessary to discharge the domestic sewage from two of the districts if the present system is carried out. The interceptors used on these sewers are of the gravity type, and are reported to have worked satisfactorily. When the flow in the combined sewer is small, corresponding to the dry-weather flow, the opening in the bottom of the sewer and the drop between the two sides is so designed that any desired part of the sewage passes into the intercepting sewer, whereas, when this volume is increased by storm water, the resulting velocity is sufficient to carry practically all the sewage into the outfall.—*The Engineering Record.*

THE MARKET FOR PAVING BRICK.

The market for paving brick, as well as of any other manufactured article, is of prime importance, and a few thoughts on this branch of the broad subject may not be out of order.

At present the finding of a market is not giving manufacturers much concern and may not for some years to come, although this can not be foretold with certainty.

Within the last few years popular favor has turned towards brick as a material for street paving, and, as the country has been prosperous and times good, all cities and towns, of any considerable size, have instituted systems of paving and are using brick in the majority of cases.

In the previous numbers of this series of papers, the advantages of brick as a paving material over others in use was shown, and thus was demonstrated the wisdom of the people in giving brick the preference. The result of this movement has been an active demand for brick suitable for the purpose.

The conditions under which these bricks are placed and the essential peculiarities of their construction are different from those of the brick previously manufactured, and used for other purposes.

New factories have been built in various parts of the country especially planned for the manufacture of paving brick.

Up to the present time they have enjoyed a good demand for their products, but observation and experience have already taught that the demand in any one place is uncertain and fluctuating.

Paving with brick is nearly all done by incorporated cities and under the instructions of the city authorities. The condition of the finances and the wills of the councilmen each exert an influence upon the amount of paving that may be done. No one can tell very long before what action will be taken, although the subject may have been agitated and talked of for a long time. Finally the council orders certain streets and alleys paved, and instructs a committee to advertise for bids from contractors to do the work. One of the conditions by which the contractor is to be bound is that he shall complete the work within a certain time. The time given before the opening of bids is ample to allow contractors to look for places to buy brick, but the time within which the work is to be completed is not usually long enough to allow an ordinary plant to make the number necessary to complete the job. This creates a demand beyond the local supply and has a tendency, not only to lead those already engaged in the manufacture of paving brick to enlarge their plant at a considerable expense, but it also tempts new parties to invest capital in new plants. The city that creates this demand may not be in a condition financially nor the aldermen in the mood to do more paving immediately after the completion of the first contract, and, in fact, may not do much more for several years. This is not an unlikely state of affairs, and has happened in the past. Such action, or inaction, would leave the manufacturers with their plants on their hands and no home market for their goods. They then have left the choice of three things, shut down the factory, continue to manufacture brick and hold them for future sales, or go out into the world and seek a market elsewhere.

If they chose the first and stop manufacturing brick, they are without any occupation, or at least have lost this one. They are being deprived of the opportunities of making money that they expected when they built their plant and embarked in the business. Not only do they suffer the loss of the expected income, but the capital which is invested in its business is tied up without giving any returns; neither can it be used by the proprietor to engage in any other enterprise. He can not even mortgage it for all it is worth, and let it fall into the hands of capitalists, for no one of good business judgment will lend money on a factory that is dead because there is no market for its goods.

Capital is always readily obtained for enterprises that have the appearance of thrift and prosperity, and that promise to give fair returns, but is very liable to be shy of anything that, to the casual observer, shows the opposite, and that is seeking the aid of new capital with the forlorn hope of adding new life to its already dead or dying boom.

Should the manufacturers choose the second course, and continue making paving brick when they have no immediate market for them, they must store their product and hold it until a local market is created for them through the actions of the city council.

Any one who has had experience with bodies of public officials knows that they are very uncertain, and that no safe and sure predictions can be made beforehand as to their actions.

There are two elements of uncertainty to be met with here. One is the action that may be taken by the board in office, if they take any action at all upon the subject of paving, and the other is that the next election may place new men in office. It can not be foretold who the new men will be, much less what views they may hold or what action they may take in the matter.

During all of this indefinite waiting, the expenses of operating the plant must be met. This money is stored in the stock of brick on hand. Few of the average plants are owned by men who are strong enough financially to continue upon this plan for very long.

It is true that money might be borrowed to attain this end, but this would add the interest to the expense account and reduce the profits by the amount.

The third method, that of going out into the world and seeking a market elsewhere, has several objectionable features, and introduces several items of expense that must be taken from the price received for the brick. While it is customary at present to sell manufactured goods by means of traveling men, sent out by the manufacturers to call upon the prospective buyers and solicit their orders, it must be conceded that this item of expense must be borne by the manufacturers and added to their expense account, and apportioned to the goods sold.

The brick sold away from home

must be transported from the producer to the consumer at a considerable expense, which must be either added to the cost to the consumer or deducted from the profits of the producer.

Brick are carried at a low rate of freight, but their weight is so great in proportion to their value that the cost of shipping by rail is comparatively much greater than that of other manufactured articles. This virtually excludes brick from the same advantages that are enjoyed by manufactured goods in general, whose cost of transportation is not such a large per cent. of their value.

It is commonly considered that the markets for manufactured articles are to be sought throughout the world, or at least in all parts of the country in which they are made, but paving brick can not be considered as coming under this rule.

Because of the greater cost of transportation the makers of paving brick must look for their market wholly within a comparatively limited circle.

Probably all the paving brick that are made are sold within a few hundred miles of the factory. This suggests the thought that it may not be well to establish plants of too large capacity at or near the same point.

While at present it may be true that there is an active demand for paving brick, beyond the supply, it should be remembered that in this, as in all other industries, over-production is a possibility.

It is not uncommon to hear of extensive manufactories running on short time or shutting down altogether for a time to guard against over-production and the attendant reduction in prices. Only recently the large milling interests were considering this very problem.

All are familiar with the actions of the "coal barons" of the East, and of various other large corporations engaged in different lines of business in solving this problem.

So long as those branches of the world's industries which find their markets in the daily needs of every home and throughout all countries of the globe have met and are compelled to cope with the question of the relative proportions, or disproportions, of supply and demand, it is not unwise for the manufacturers of paving brick, who have to seek their markets within a limited area, and who find their custom in the uncertain actions of municipal authorities to anticipate this matter and be prepared to meet it in all its phases.—*Clay-Worker*.

IMPROVEMENT AND CONTRACTING NEWS

PAVING.

Beatrice, Neb., has voted to issue $20,000 in bonds for new paving.

The sum of $22,186 was expended in 1892 for street cleaning in Omaha, Neb.

Baraboo, Wis., has recently laid out about $100,000 in municipal improvements.

Anderson, Ind., streets are being paved with brick at a cost of $1.73 per square yard.

The Bradford, Mass., selectmen are authorized to petition the legislature for right to extend the debt limit by $25,000 for paving Main street.

The city clerk of Gallipolis, Ohio, writes that that city is preparing to do a large amount of paving this season.

The Denver, Colo., city charter will probably be revised so that property owners shall pay the full cost of paving.

City Clerk R. B. Dennis, of Des Moines, Ia., writes that the city will soon advertise for bids for about five miles of paving.

The chamber of commerce of New York City has requested the legislature for macadamized roads throughout the state.

Evansville, Ind., proposes to pave with brick about 96,000 square yards of streets. The contracts will be awarded in March.

Edward Hough, city engineer of Sedalia, Mo., writes that contracts will be let in a month or two for paving on several streets.

Orlando, Fla., streets are being paved with clay which hardens and becomes practically impervious to water when properly laid.

Arrangements will be made for paving one and one-half miles more of Second street, Ashland, Wis. Cedar blocks will probably be used.

The street committee of Chicago wants an appropriation of between $3,000,000 and $4,000,000 for the work of cleaning and repairing streets this year.

A contract is to be let for paving with "metholithic," "granolithic" or "cinderlithic," a public alleyway sixteen feet wide and three hundred or more feet long, in West Chester, Pa. For further information address Samuel D. White or D. Morgan Cox.

Frank Suddoth, city clerk of Mt. Vernon, Ill., will advertise for sealed bids for about eleven miles of street paving with crushed limestone. The estimated cost is $125,000.

Wm. G. Smith & Son, of Norristown, Pa., have, during the past year, put down some 50,000 square feet of their improved and ornamental cement flooring in the State Hospital for Insane at Norristown.

The bonds ordered sold by the Delaware, O., council, for the improvement of North Franklin street, were awarded to the Croghan Bank, of Fremont, O., at a premium of $16. The amount of the bonds was $1,146.80.

Charles G. Carlson, city clerk of Moline, Ill., says that an ordinance has been passed providing for the brick paving of parts of Thirteenth, Fourteenth, Fifteenth, Sixteenth, Seventeenth and Eighteenth streets.

Oakland, Cal., has already expended $19,000 in partially constructing a public boulevard around Lake Merritt. The city council has transferred $40,000 from the general fund to the park and boulevard fund, so that the work of improvement can be continued at once.

The Boston common council has requested the finance committee to provide for widening Poplar street, $5,000; paving West Newton street with asphalt or brick, $8,000; paving Boylston street with asphalt or brick, $10,000, and paving Piedmont street with block stone, $5,500.

Frank R. Hoyt, a wealthy New York gentleman who has a handsome residence at Watkins where he spends much of his time, has offered to give to that village a stone crusher costing about $1,000, providing the authorities will furnish power to operate it and material for macadamizing the streets.

The cost of work under the direction of the department of public works of Buffalo, N. Y., during 1892 was as follows: bureau of engineering, $1,821,134; bureau of water, $725,269; bureau of streets, $592,230; bureau of buildings, $253,803. Buffalo has 257 miles of paved streets, principally stone and asphalt, 132 miles of unpaved streets. C. D. Zimmerman and Messrs. Cooper & Hopkins have the contracts for street-sweeping and cleaning for three years. The collection of garbage is done by the city.

The present contract expires June 1, and the board of public works has been authorized to advertise for proposals to do the work of disposing of the garbage after the present contract expires.

The city engineer of Covington, Ky., has estimated the cost of paving with brick Greenup street, from Second to Twentieth, and Scott street, from Fifth to Twentieth, at $190,692.50. As the estimate was higher than the city councilmen had supposed it would be, it is probable that brick pavements will not be laid on those streets this year.

CONTRACTS TO BE LET.

Proposals are wanted for paving several streets in Creston, Ia.

Collier street, Binghamton, N. Y., is to be paved with asphalt in the spring.

Owensboro, Ky., will pave its streets with brick at an estimated cost of $200,000.

Ironton, O., will invite bids for paving ten squares of Third street with fire brick.

Ashtabula, O., will probably let contracts in March for 20,000 square yards of brick pavement.

Parts of Miller, Liberty, Flora and Gorman streets and Dalton avenue, Cincinnati, Ohio, will be paved.

Jefferson street, from Main street to the C., B. & Q. R'y Co.'s right of way, Ottumwa, Iowa, will be paved and curbed.

Bids are wanted for watering the macadamized streets in the Back Bay and South End districts of Boston for three years.

Prospect street, from Main to Cherry, and West Main street from the Ohio canal to Henry street, Massillon, Ohio, are to be paved with brick.

St. Louis, Mo., will reconstruct twenty-six streets and alleys with granite, two with asphalt, one with brick, and three with Telford pavement.

The Canton, Ill., city council has instructed the street and alley committee to advertise for bids for paving as soon as practical. About 53,000 square yards of paving is to be done, requiring 18,400 lineal feet of curbing and 10,330 cubic yards of excavating.

The following streets in Brooklyn, N. Y., are to be graded and paved: President street, from Closson avenue to Rogers avenue; McKibben street, from Bushwick avenue to Bogart street; Degraw street, from Franklin avenue to Bedford avenue, and Fifty-first, Fiftieth, Forty-eighth and Forty-seventh streets, from Third avenue to Second avenue.

Ordinances have been passed for the paving of Belle street, Fourth street, between Piasa and State, and Second street, between Henry and Cherry, Alton, Ill. Estimates for the entire paving amount to $42,504.

More brick pavements are being planned in Quincy, Ill. Twentieth street, from Ninth to Eighteenth avenues; Eighteenth street, from Third to Seventh avenues, and Fourth avenue, from First to Twentieth streets, are to be paved.

Fulton street, from Bancroft to Webster, Toledo, Ohio, is to be paved with asphalt on a foundation of hydraulic cement concrete. Bids will be received until noon, February 13. Jefferson street will be improved with brick, cedar blocks, Hallwood blocks or asphalt.

CONTEMPLATED IMPROVEMENTS.

Muncie, Ind., will do considerable paving in the spring.

Considerable paving has been authorized at Fostoria, Ohio.

Fifty-four additional streets in Buffalo, N. Y., will be paved this year.

The question of paving Main street, Hutchinson, Kan., is being discussed.

Homestead, Pa., will expend $55,000 in grading and paving at an early date.

Elgin and Aurora, Ill., will do a considerable amount of street paving this year.

About two miles of brick paving will be constructed in the spring at Defiance, Ohio.

The city engineer of Winona, Minn., will prepare plans for paving ten streets with brick.

It is proposed to pave Easton avenue, St. Louis, Mo., a distance of three miles with asphalt.

The list of streets to be paved this year at Montreal, Que., includes nine with asphalt and four with block stone.

Colorado street, Pasadena, Cal., will probably be paved when connections with the sewer system are completed.

I. D. Wolfe, city clerk, of Goshen, Ind., writes that the city will probably order six to eleven blocks of pavement in the near future.

The San Francisco board of supervisors has passed resolutions of intention for the paving of twenty-five streets. Five streets are to be opened and extended.

The paving of east Eleventh street and parts of Charlotte street and Michigan avenue, Kansas City, Mo., is contemplated. There is talk of converting Fifteenth street into a boulevard with asphalted driveway.

T. L. McConnell, of Lexington, Ky., informs us that bids will be advertised for for the construction of Sixth street from Upper to Broadway, with macadam roadway.

The Elmira, N. Y., city council has voted to extend South avenue from Perine street to South Broadway. This will add to the Fifth ward a street 724 feet long and 50 feet wide.

J. C. Kuhlmann, city clerk of Wausau, Wis., writes that there is a movement to pave about six blocks of their principal streets this summer, but as yet no definite steps have been taken.

The city charter of Murfreesboro, Tenn., is being amended so as to enable the enforcement of the "sidewalk law;" as a consequence, considerable street work will be done there this year.

A bill is being prepared for the legislature authorizing the city of Dayton, Ohio, to issue bonds for $500,000 for paving. Three additional streets have been ordered paved, to cost about $150,000.

Ashland, Wis., feels the need of a thoroughly good drive. A drive about five or six miles in length will probably be formed by the opening of Eighteenth street from Ellis avenue to the cemetery and driving park.

The Cleveland, Ohio, city council has voted to pave fifty-two streets this year. The total distance is 20.8 miles, and is divided as follows: Dressed block Medina sandstone, 66,268 feet; common Medina sandstone, 24,184 feet; brick, 11,248 feet; asphalt, 8,512 feet. The city is planning street work to cost about $1,200,000.

One of the greatest improvements that lower New York has ever known is the contemplated opening of Elm street through to Great Jones street and Lafayette place. It has been talked of for twelve years. Its cost is estimated at nearly $3,000,000, but the money is likely to prove well invested. Starting from the plaza formed by the junction of City Hall place, Reade and Center streets, the new thoroughfare, eighty feet wide from end to end, will proceed north until it merges into Lafayette place, which is 100 feet wide, and which ends in the plaza at Eighth street. The new street will be only one block east of Broadway, and the traffic on that thoroughfare will thus be partly relieved. Beginning at Great Jones street, several whole buildings will be taken, and throughout the whole length of the street it will be necessary to chop off from fifteen to thirty feet of buildings. Twenty feet will be taken from the rear of an old Episcopal church and twenty-five feet from the new Puck building. Even picturesque old Tombs will lose eighteen feet of its rear wall, but the city will gain a fine new street where it is badly needed.

City Engineer John R. Seibert, of Pekin, Ill., informs us that estimates for 14,812 square yards of pavements are now before the county court for confirmation, and if confirmed, contracts will be let at an early date. The Peoria Paving Block Company secured the contracts for paving last year, and also built 1,400 feet of five-foot sewer.

The Jamestown, N. Y., board of public works has recommended the following work: 72,721 sq. yds. brick paving, estimated cost $2 per sq.yd.; 7,610 sq.yds. stone paving, $3.25 per sq.yd.; 32,436 lin. ft. stone curbing, 42 cents per lin. ft.; 2,136 lin. ft. iron gutter, $2.30 per lin. ft. Bonds are asked for $60,000 to pay the city's share of the expense.

The Wightman tract of land in Milwaukee has been purchased by Chicago and Milwaukee capitalists. Lake avenue and Newberry place are to be paved with asphalt, and the latter, which is 159 feet wide, will have a park fifty feet wide running through the center, with a roadway on either side. Every street in the tract is to be improved, and the city's gas, sewer, and water systems introduced before any lots are offered for sale.

CONTRACTS AWARDED.

E. C. Culver has a contract for street paving in Boone, Iowa, to commence March 15.

E. G. Church has been awarded the contract for one-half mile of street paving in Sedalia, Mo., with "improved Telford," at $2.00 per square yard.

The following contracts for paving brick have been awarded in Washington, D. C.: Charles Ford, 100,000 to 500,000, at $9.50 per M.; Washington Brick and Terra Cotta Company, 50,000 to 200,000, at $10, and $11 per M.; Ivy City Brick Company, 50,000 to 300,000, at $10.50 per M.

A. J. Pugh & Co, of Columbus, Ohio, have recently completed a contract for paving Main street, Richmond, Ind., from Sixth to Ninth streets, with Canton Standard paving brick, and also a contract for paving Converse street, from Main to Angle streets, Dunkirk, Ind., with "Parto Block."

The Mt. Vernon Brick Co. has been awarded the contract for building about nine miles of brick walks in Mt. Vernon, Ill., and the Missouri Granitoid and Sidewalk Co. has the contract for two miles of brick walks and half a mile in addition to the three miles of granitoid walks they have already laid. The Indiana Contract Co., of Evansville, Ind., have the contract for constructing about four miles of street with crushed stone and Paducah gravel.

A contract has been awarded to Isaac F. Reeder, Indianapolis, Ind., for sweeping streets and alleys paved with brick, at sixty cents per 10,000 square feet, and Kentucky avenue, which is paved with asphalt, at thirty-five cents per 10,000 square feet, the sweeping to be done either daily or tri-weekly.

David Ryan, of Alton, Ill., has secured the contract for paving and curbing Main street, Venice, Ill., for $26,000. Mr. Ryan's bid was $1.55 per square yard. The contract calls for six inches of sand at the bottom and two courses of brick. The brick will be of Alton manufacture, and Venice will be the first town to use that product.

Repairs to asphalt pavements in Cincinnati during 1893 will cost the city about $8,300. Contracts for repairs have been let as follows: The Trinidad Asphalt Company, Seventh, from Vine to Freeman, $1,000 per annum; Walnut, $520; Eighth, $150; Ninth, $1,500; Main, $480; Central avenue, $108; Seventh, from Freeman to Carr, $90: Warren-Scharf Company, McMillan, $860; Garfield Place, $50; Government Square, $30.

J. F. Barrett, city clerk of Sterling, Ill., sends us the following information: A contract was let on Jan. 16 for grading, paving and curbing five blocks of Third street in the business district. The bids were—John Bassler, Galesburgh, Ill., $28,784.95; Henry Bessler, Cedar Rapids, Iowa, $27,612.98; C. E. Loss, Chicago, $34,365.06; Rockford Construction Co, Rockford, Ill., $26,425.50; Edwards & Walsh, Davenport, Iowa, $28,223.06; Wilson & Thatcher, Chicago, $25,778.16, and J. P. Calnan Construction Co., Clinton, Iowa, $32,958.60. The contract was awarded to Wilson & Thatcher. who have filed bonds and begin work April 1. The contract ends July 1, 1893.

SEWERAGE.

The Rogers Park, Ill., village council has adopted the gravity system of sewers.

The estimated cost of a sewerage system at Glenwood Springs, Colo., is $13,000.

Wheaton, Ill., has voted down a plan for building sewers, as being too expensive.

The new sewerage system of Tyler, Texas, will cover twenty-eight blocks in the principal parts of the city.

It is probable that the original estimate of $186,384 for twenty-eight miles of sewers in Everett, Mass., will be exceeded by $100,000.

One of the most extensive and complete sewer systems in the West has just been completed in Deadwood, S. Dak., at a cost of $40,000. E. J. Lawton was the contractor.

Adrian, Mich., has laid a twelve-inch pipe sewer with twenty-two Y junctions; length, 888 feet; average depth, seven feet; cost per lineal foot, 58 cents; wages paid, $1.50 per day.

The Sixth street sewer, Great Falls, Mont., is now completed. It is over half a mile long, four feet in diameter on the inside, and laid in two courses of brick. This sewer, which is the largest in Montana, has cost the city $20,000.

Health Commissioner Wingate, of Milwaukee, is making an effort for the establishment of a drainage commission, with a view to remedying the evil caused by drainage flowing into the Menomonee river. While the completion of the intercepting sewer system next spring will do away with city sewerage going into the river, still the river will continue to be polluted by the drainage of a district in which more than 10,000 people reside.

CONTRACTS TO BE LET.

Nelsonville, Ohio, will construct a sewerage system this year.

Sewers will be laid in Third and East Fifteenth streets, Oakland, Cal.

The city clerk of Des Moines, Ia., will advertise for bids for eight miles of sewers.

J. W. Sparks, Jr., writes that Murfreesboro, Tenn., will soon put in a $30,000 system of sewers.

Contracts for about two miles of sewers in Scottdale, Pa., will probably be awarded about March 1st.

Hinds & Bond, of Watertown, N. Y., are making plans and surveys for sewers in Carthage, N. Y., contracts for which will be let soon.

Ordinances have been passed for the construction of sewers in five streets in Newark, N. J. Assessments are being made for pipe sewers in ten streets.

An ordinance has been passed authorizing the department of public works to enter into contracts for construction of sewers in thirty-nine streets of Philadelphia.

Proposals will be received at the auditor's office, of Hastings, Minn., until March 14th for the construction of a sewer from the jail to the Mississippi river according to the plans and specifications on file.

Bids will be received at the office of J. A. Stevenson, city clerk of Monmouth, Ill., until noon, February 6, for the construction of 1,040 feet of thirty-inch brick sewer and 39,000 feet of pipe sewer, six to twenty-four inches.

*CONTEMPLATED WORK.

Ironton, Ohio, will spend $20,000 on the sewer system.

Valdosta, Ga., will probably have a sewerage system.

Sacramento, Cal., wants a new and better sytem of sewerage.

Southington, Ct., will probably construct a new sewerage system.

A sewerage system is proposed for the first ward of Syracuse, N. Y.

Plans are being prepared for a system of sewerage in Taylorville, Ill.

Sioux Falls, S. Dak., contemplates the construction of sewers to cost $150,000.

Extensive improvements in the sewer system of Peoria, Ill., are contemplated.

A large sewer around the public square in Centerville, Iowa, is again being agitated.

The common council of Troy, N. Y., is considering the construction of about 25,000 feet of sewers.

The construction of a sewer system is being urged at Brunswick, Ga., at an estimated cost of $60,000.

The mayor of Manchester, N. H., recommends that bonds be issued for the extension of the sewer system.

A survey of the village of Geneva, N. Y., is being made with a view of establishing an extensive system of sewers.

The San Francisco sewerage commissioners have recommended the construction of sewers in Scott and Filbert streets.

Holyoke, Mass., will expend $300,000 in sewer construction this year. A system is needed in Elmwood, Oakdale and Springdale.

The city council of Tacoma, Wash., is considering plans for a sewer to drain about 800 acres, and estimated to cost $41,700 to $44,500.

North Denver, Col., property owners are urging operations on the new sewer district as recommended by the board of health.

The sewer frontage of the new sewer district No. 2, Aurora, Ill., is 40,000 feet, and the estimated cost of construction is about $70,000.

M. P. Schooley, clerk of Homestead, Pa., writes that an election will be held February 21 for the purpose of borrowing $15,000 to build a sewer.

A gravity sewer system is discussed in Salt Lake City, Utah. Sewer extensions are to be made on West Temple and Second East streets.

Engineer H. J. Reid, of Colorado Springs, Col., has prepared plans for a system of sewers for Boulder, Col., which is estimated to cost $36,000.

Geo. E. Waring, Jr., of Newport, R. I., has just completed sewerage plans for Weirs, N. H., and Charlottetown, Prince Edward Island, Canada.

H. C. Allen, city engineer of Syracuse, N. Y., has prepared plans for a 6x8 ft. stone sewer in the Harbor Brook Valley. The estimated cost is $280,000.

Frank Snyder, sanitary engineer, of Columbus, O., has prepared a plan of main sewerage for the village of London, O. The estimated cost of the same is $73,000.

The city engineer of Columbus, O., is preparing a plan and estimate for the extension of the southeast main trunk sewer from its terminus in Forest street to Oakwood avenue.

Plans have been completed for the proposed sewer in the sixth ward, Portsmouth, O. It will drain 225 acres, and cost about $30,000. There will be 7,830 feet of brick sewer and 6,830 feet of pipe.

The board of public works of Saginaw, Mich., has recommended the construction, during the present season, of the sewer in Vermont street, from Hamilton to Fayette street, at an estimated cost of $4,100.

Engineer Elliott, of the Memphis, Tenn., sewer department, estimates that a main 36-inch sewer along Georgia street from the river to Mississippi avenue, can be constructed for between $60,000 and $70,000.

The Nashville, Tenn., city council proposes to spend $400,000 for sewer purposes this year. The legislature has been petitioned for authority to issue bonds to this amount. The sewers to be constructed will be principally main sewers, built of brick.

Plans for a new $60,000 sewer are being prepared at Kansas City, Mo. There will be two miles of brick main from two to four and a half feet in diameter, and 16,750 feet of twelve-inch pipe. There are to be ninety-six catch-basins and thirty-three laterals.

The sewer board of Far Rockaway, N. Y., has voted in favor of the gravity system of sewerage, and the plans of T. D. Smith and J. J. Powers for sewage disposal. The estimated cost of constructing the proposed 14,560 feet of sewers, gravity system, is $24,000 to $29,000. The deepest cut is 14 feet 8 inches, and average cut 9 feet. It will be necessary to erect disposal works, as by a decision of the state board of health the village can not empty its refuse matter into the bay or the ocean. This will increase the expense by about $65,000.

The question of sewers in Berwick, Pa., will be voted upon on the 21st of February. Complete plans and specifications have been prepared by Alex. Potter, of Olean, N. Y. It is proposed to construct eight miles at present, at an estimated cost of $45,000. Pipe sewers ranging from eight to twenty inches will be used.

The Cleveland, Ohio, Board of Control has prepared plans for sewers in five streets. Work will be commenced early in the spring on the Walworth Run sewer, which will be fifteen feet in diameter, and will empty into the river. Its estimated cost is $200,000, and its construction will occupy about two years. It will drain nearly all of the West and South sides, and is to be built so as to connect with a main sewer under the river, if one is built.

WATER-WORKS.

The Minneapolis, Minn., city water-works department last year netted over $100,000.

Chief Engineer Robert Van Buren, of Brooklyn, N. Y., estimates that it will require over $3,000,000 to place the works in a proper condition to supply the city,

The Manchester, N. H., board of water commissioners have asked for appropriations amounting to $132,000 for the use of the water department during the current year.

The city of Boston has purchased the property of the Jamaica Pond Aqueduct Company at $125,332. This system furnishes the water supply for Roxbury and Jamaica Plain.

The contract for the firs section of the new supply conduit, at Rochester, N. Y., 12,000 feet of masonry conduit, 6 to 6½ feet high and wide, has been awarded to Wm. H. Jones & Sons, for $292,513.

The wooden pipe portion of the new water-works system of Logan, Utah, has been laid. It is a continuous redwood pipe, bound with iron bands, and is capable of resisting an immense pressure.

Council Bluffs, Iowa, has an admirable water-works system. Water is taken from the Missouri river at a point north of and above the city, and is pumped through a closed iron conduit to three large reservoirs in the city. It is conducted from one to the other of these reservoirs, being allowed to settle in each, and from here is pumped to a large distributing reservoir. The water-works company made extensive improvements last year, adding one new reservoir and a system of weirs between the reservoirs. All the reservoirs are cemented on the sides and bottom. The works are capable of furnishing 8,000,000 gallons of good, clear water each twenty-four hours, while from 15,000,000 to 20,000-000 gallons can be pumped from the river into the reservoirs each day. This city is provided with over 1,000,000 feet of mains and 275 fire hydrants.

CONTRACTS TO BE LET.

Lacrosse, Wis., will lay $25,000 of mains this year.

The Bonham, Texas, city council is open for bids for a water-works system.

The Beatrice, Neb., water-works plant is to be completed at a cost of about $7,000.

The Cleveland, Tenn., board of aldermen have accepted plans for a system of water-works to cost $40,000.

A reservoir with a capacity of 1,000,000 gallons is to be built in connection with the water-works system of Rockford, Ill.

Water-works will be put in at Columbia, Mo.; Grayton, W. Va.; El Paso, Tex.; Alabaster, Mich.; Elberton, Wash ; Girard, Pa.; Groesbeck, Tex.; Kenosha, Wis.; Fitchburg, Mass.; Coxsackie, N. Y.; Wilson, N. C.; Nelsonville, O.; Bowie, Tex.; Edinburg, Ind., and DeKalb, Ill.

CONTEMPLATED WORK.

A water company is proposed at North Woodbury, Conn.

Another private water plant is talked of at Fayetteville, N. C.

Spokane, Wash., has decided to spend $312,000 in the laying of pipes.

A water-works system for Dillon, Mont., is being discussed. The estimated cost is $25,000.

Rockvale and Lafayette, Colo., are making preparations for putting in water-works.

Contemplated improvements in the water-works system of Sarnia, Ont., will cost $17,000.

Northumberland, Pa., will probably put in gravity works with thirty hydrants, in the spring.

The city council of Connersville, Ind., is debating the question of an improved system of water-works.

DeKalb, Ind., intends to increase its water supply. Alderman Everett is chairman of the water committee.

City clerk of Bushnell, Ill., writes that the council has voted to sell or lease the city water-works to any one who will pipe water a distance of four miles from springs and guarantee a supply, the city to again purchase the works after the improvements are made. The works cost about $25,000.

Edinburg, Ind., will build water-works. There will be two miles of mains, fifteen hydrants, wells, pumping plant and a standpipe.

The water-works of Yonkers, N. Y., need an additional storage capacity of 550,000,000 gallons, which may be secured by building a short dam across an existing supply pond and building the proposed Palmer Hill reservoir, with a capacity of 333,000,000 gallons.

Bonds to the amount of $250,000 have been ordered issued to begin the construction of a high service system in New York City, including a 24,000,000 gallon pumping station and a large water tower. The city has the authority to issue $500,000 of bonds for the system.

Engineer S. E. Babcock, of Little Falls, N. Y., has reported on village water-works for Fort Edward, N. Y., recommending a gravity supply, two reservoirs, a filter chamber, an 8,160-foot supply main of 20-inch pipe, and a distributing system. The estimated cost, exclusive of land and water rights, is $106,087.

City Engineer Clarke, of Chicago, Ill., has estimated the cost of extending the two-mile tunnel two miles and a half further into the lake, at $778,000. The extension is being considered as a means of keeping the four-mile tunnel water free from pollution when the supply from the two-mile crib is impure. Mr. Clarke says the extended tunnel must have a diameter of ten feet ten inches in order to supply the old tunnels running from the crib to the shore.

The water-works question is being discussed at Davenport, Wash., Brattleboro, Vt, Newman, Ga., Turner, Ill., Hartington, Neb., Colville, Wash., Fort Edward, N. Y., Cameron, Texas, New Cumberland, Ohio, Duquesne, Pa., Lakewood, N. Y., Northfield, Vt., Pepperell, Mass., Newton, N. J., Valdosta, Ga., Grille, Miss., Water Valley, Miss., Napoleon, Ohio, Centerville, Iowa, Nelsonville, Ohio, Oakley, Texas, Colby, Texas, Newton, Iowa, Geneva, Ohio, and South Charleston, Ohio.

CONTRACTS AWARDED.

Stanberry, Mo., is constructing its own water-works, as no suitable bids were received on contract.

The contract for putting in water-works at Carthage, N. Y., has been let to Moffett, Hodgkins & Clark, of New York. C. O. McCombs is overseeing the construction of same.

J. F. Wilson, city clerk of Grinnell, Ia., writes that the city has a contract with J. P. Miller & Co., of Chicago, to drill a well and guarantee to furnish 150,000 gallons of water suitable for culinary and mechanical uses. The contract price is $3 50 per foot, but in no case is the city to pay for over 2,000 feet. The city expects to put in water-works costing from $25,000 to $30,000, and sell bonds to pay for the same.

BRIDGES.

Atwood, Colo., wants a new bridge.

A new bridge at D street, Marysville, Cal., will be built in the fall.

A bridge is wanted across the river at Columbus street, Jackson, Mich.

A new bridge is to be built across the river on Central avenue, Delaware, O.

The question of a bridge across St. Louis bay from West Duluth to Superior, is again being discussed.

The question of a bridge over the Mississippi river at New Orleans is being very thoroughly discussed.

It is proposed to construct a viaduct across the Menominee valley at Sixteenth street, Milwaukee, Wis.

The citizens and common council of Red Wing, Minn., are in favor of bridging the Mississippi at that point.

The F. & P. M. R. R. Co. will construct an iron bridge across the Saginaw river, near Flint, Mich., at a cost of $50,000. Contracts for a portion of the heavy work have already been let.

The Milwaukee Bridge Company has secured contracts for building an iron bridge across the Wisconsin river at Merrill, Wis., for $16,490, and across the Yellow river at Marshfield for $3,123.

The bridge across the valley between Brooklyn and Brighton, O., which was built seven years ago at a cost of $40,000, is dangerous. A new one will probably be constructed at a cost of $125,000.

A bill has passed the Dayton, O., city council, providing for the issuance of bonds for the construction of a $35,000 viaduct at the Third street crossing. The railroads will be assessed for half this amount.

Patrick Maley has been awarded the contract for building a stone bridge at Dayton, Tenn. We are informed by Howard Teasdale, city clerk, that a contract will be let for the building of a bridge in Sparta, Wis.

If the plans are carried out, the proposed wagon road, footway and electric railway over the Merchants' bridge at St. Louis, Mo., will be built before the close of the present year. The estimated cost is $350,000.

A viaduct will be constructed over the tracks on West O street, Lincoln, Neb. The roadway will be twenty-five feet wide with a sidewalk six feet wide on each side. The structure is to be supported by wrought iron columns, with stone pedestals. Between the columns will be steel girders strong enough to support a maximum load in addition to the weight of the bridge.

STREET LIGHTING.

Bids are being received for street lighting in Columbus, Ga.

Kansas City, Mo., will soon operate an electric light plant of its own.

Richmond, Ind., is willing to expend $40,000 for a good electric light plant.

Fifty additional electric street lights have been contracted for at Mascoutah, Mo.

The city council of New Castle, Ind., has voted to purchase and operate an electric light plant.

D. E. Fox, city clerk of Carrollton, Ill., says the electric light question is being discussed there.

City Clerk T. F. Higby, of Fairfield, Ia., says that city is looking into the incandescent lighting business.

An apportionment of $87,500 has been made for 789 additional electric street lamps in New York City.

A contract has been made for lighting Muskegon, Mich., for the next five years. Each light will cost $93.50 per year.

The board of public works of Jamestown, N. Y., has recommended that the municipal electric light plant be extended, at a cost of $15,000.

Electric light plants will be put in at Toreley, Md.; Franklinville, N. Y.; Columbia, Mo.; Mineral Ridge, Ohio; East Orange, N. J., and Chenoa, Ill.

The proprietors of the Pomona, Cal., Gas and Electric Light Company have determined to put the gas rate at $2 per 1,000 cubic feet, a concession of not less than 33⅓ per cent.

I. W. Holt, city recorder of Dayton, Tenn.. informs us that contracts are to be let for from 70 to 100 gasoline or oil street lamps; also for erecting the same, furnishing, posts, etc.

Electric street lights are discussed at Paris, Tenn.; Clyde, O.; Stanhope, N J.; Cheshire, Mass.; Gainesville, Fla.; Shelbyville, Ky.; Kendallville, Ind.; Georgetown, Tex.; Waynesville, N. C.; New London, O.; Plymouth, O., and Onalaska, Wis.

The Boulder Electric Company has been awarded the contract for lighting the city of Boulder, Colo., for another year at $9.50 a lamp per month, a decrease of thirty cents per light per month.

Ann Arbor, Mich., has contracted with the Ann Arbor Thomson-Houston Electric Company for eighty-five arc street lights, of two thousand candle power each, at eighty-one dollars per lamp per annum.

The committee on lights of the Richmond, Va., councils wants bids for the auxiliary water gas plant to be erected at the city gas works. An appropriation of $25,000 for the purpose has been agreed upon.

Alton, Ill., is considering bids for electric lighting. Owing to a failure to come to any agreement as to price, the Alton Gas and Electric Light Co. has refused to furnish either gas or electricity to the city since January 1st.

It is reported that all the electric railway and electric light companies in Maine are to be consolidated into one company with a capital stock of between $4,000,000 and $5,000,000. It is stated that the company will ask the next legislature for a charter to buy a lease to build and operate street railways, light, heat and power companies throughout the State.

F. A. Smink, secretary of ths Shamokin, Pa., council, informs us that that city has contracted with the Shamokin Arc Light Company for 35 arc 2,000 candle power all-night lights, at $90 per light per year, and with the Shamokin Electric Light and Power Company for 26 lights at $90 per light per year, and eight lights at $60 per light per year, contracts to run five years.

PUBLIC PARKS.

There is a move for park improvements in Burlington, Iowa.

The Madison, Wis., fair grounds may be purchased by the city for park purposes.

The West Park Board, Chicago, has appropriated $100,000 for a museum in Garfield park.

The Franklin Park commissioners of Columbus, Ohio, will petition the legislature for authority to issue bonds for $100,000 for park improvement.

Some Boston capitalists have about decided to build an electric road from Wilmington, Del., to Brandywine Springs. If they succeed in purchasing the grounds there they will convert them into a public park, with such attractions as will make them a popular resort.

An amendment to the city charter of Denver, Col., will probably be made so as to allow the city to create a bonded indebtedness, the money thus obtained to be used in the purchase of ground for park purposes.

The cost of maintaining the parks of Seattle, Wash., last year was $22,337. The estimate for the ensuing year is $27,827. The park commissioners propose to locate a grand park from Madison point through Hunter's glen and reaching to the peninsula on the west shore of Lake Washington. They want a boulevard not less than seventy-five feet wide and extending from Bailey's point to the north line of McGilvra's property on Union bay, closely following the shore line.

The sum of $100,000 is set apart for buying a park in the southeast part of Omaha, Neb., and $75,000 for the Parker, or some other tract, in the northeast. The value of Omaha's parks, not counting parkways or boulevards, is $1,075,000. Last year the city expended $20,017 in permanent improvements in parks.

STREET RAILWAYS.

Allison B. Laine, village clerk of Canisteo, N. Y., informs us that a street railway is to be laid there as soon as the frost is out of the ground.

THE BEST.

In recently making an examination of the literature of street paving, a gentleman who has made a thorough study of the subject found, as he says, that the most valuable matter in print had appeared in PAVING AND MUNICIPAL ENGINEERING, the files of which, he said, must be consulted by those wanting the most complete information.

The growing interest in this subject has led to a demand for early numbers of the publication, which long ago exhausted the supply. They are now hard to get at

Many Times Their Original Cost.

As the best obtainable articles on municipal engineering will continue to be supplied in this magazine, all who are interested in the improvement of cities should receive it regularly and save every number.

✦

SOME OF THE LEADING ARTICLES

IN THE JANUARY NUMBER:

MUNICIPAL EQUIPMENT AND ENGINEERING OF PARIS.
BY MAJOR JAMES W. HOWARD, B. L., C. E.

PAVING BRICK: DIFFERENCES OF QUALITY.
BY D. V. PURINGTON.

FRENCH AND AMERICAN ASPHALT PAVEMENTS COMPARED.
BY LOUIS H. GIBSON.

MAINTENANCE OF ROADS IN FRANCE.
BY ARTHUR LAGRON.

SPECIFICATIONS FOR BRICK PAVEMENTS; FOUNDATION AND CONSTRUCTION OF BRICK PAVEMENTS.
BY W. M. WHITTEN, C. E.

THE IMPORTANCE OF WIDE-WHEEL TIRES.
BY J. M. HEISKELL, C. E.

IT IS LIKED

BY THOSE WHO TAKE IT.

TAKE IT AND YOU WILL LIKE IT.

PROOF

ONLY WISH IT CAME OFTENER.

TOLEDO, OHIO, January 27, 1893.

We think your magazine a very good one, and only wish it came oftener We recommend it to all of our friends. Truly yours,

BICK & GLANN.

COVERS ITS FIELD WELL.

MINNEAPOLIS, MINN., January 18, 1893.

I have received and read PAVING AND MUNICIPAL ENGINEERING and am much pleased with it. It contains much of just such information and suggestion as every municipal engineer requires, and in fact it covers the field which it assumes to occupy better than any periodical that it has been my good fortune to read. I shall certainly subscribe.

Yours truly, CHAS. O. HUNTRESS,
Assistant City Engineer.

ITS ARTICLES ARE INTERESTING AND VALUABLE.

CINCINNATI, OHIO, January 21, 1893.

Think it one of the handsomest technical papers published. The articles are all interesting and valuable. WARREN-SCHARF ASPHALT PAVING CO.

LIKE IT VERY MUCH.

NELSONVILLE, OHIO, January 23, 1893.

Your January number of PAVING AND MUNICIPAL ENGINEERING, in new form, came to hand during our absence from home, and we have just now had time to see it. We like it very much, and do not see how you can further improve it. Yours truly,

THE NELSONVILLE SEWER PIPE CO.,
By C. H. DOAN, Sec'y and Treas.

A GREAT AID.

BAKERSFIELD, COL., January 17, 1893.

It gives promise of being a great aid in the new department of engineering, to which it is devoted. Very truly,

L. BLANKENHORN,
Sec'y Standard Asphalt Co.

SOME OF MANY COMMENTS.

INTERESTS THE BRICK CONTRACTORS.

Columbus, O., Jan. 12, 1893.

Editor Paving and Municipal Engineering:

Dear Sir—The January number of your Journal received. Am greatly pleased with its new form and dress, consider it the best magazine published on the topics it embodies, being full of timely hints and articles of value bearing on my business, which is brick street paving. But this is not the only part that interests me, for I read its entire contents and profit thereby. Yours truly, F. W. Cerny.

A WORK OF ART.

Red Wing, Minn., Jan. 13, 1893.

Your magazine certainly is a work of art and does great credit to your institution and to the cause it advocates. Yours truly.

Red Wing Sewer Pipe Co.,
C. E. Sheldon, *Sec'y.*

WHERE IT HAS HELPED.

Winona, Minn., Jan. 12, 1893.

We esteem your periodical highly and it has been of much value to us in reaching a conclusion upon paving, which we are about to enter upon here.

Yours truly, C. A. Morey,
Chairman Com.

A MODEL NUMBER.

Omaha, Neb., Jan. 12, 1893.

Please allow me to congratulate you on the January number of "Paving and Municipal Engineering." It's a model number and I trust that the same excellence will be maintained.

Very truly yours,
John Grant, *Pres.*
Grant Asphalt Paving and Slagolithic Co.

MAY IT LIVE LONG AND PROSPER.

Pullman, Ill., Jan. 12, 1893.

I am much pleased with "Paving and Municipal Engineering," in its new dress. May it live long and prosper. William Lee.

INTERESTING TO MUNICIPAL ENGINEERS.

Bayfield, Wis., Jan. 13, 1893.

The new form is truly a great improvement over the other form. All who are engaged in municipal engineering will hail with delight the contributions found therein. D. F. Glover.

THE GENERAL VERDICT.

Binghamton, N. Y., Jan. 12, 1893.

I am much pleased with "Paving and Municipal Engineering." It is very interesting and instructive. Very truly yours,

S. E. Monroe, *City Engineer.*

INTERESTED IN PAVING BRICK.

Mt. Vernon, O., Jan. 14, 1893.

I am well pleased with its appearance and as brick paving has come to stay, I eagerly devour all that is calculated to throw light on that subject.

Very respectfully, A. Cassil, *C. C. E.*

APPROVED IN ALL RESPECTS,

Philadelphia, Pa., Jan. 13, 1893.

The January number of your Journal in its new form meets with our approval in every respect. It is much more attractive and convenient than the old form and we think you will undoubtedly find it a step in the right direction. Wishing you success. Yours truly, Chambers Brothers Co.,

J. H. Chambers, *Gen'l Mgr.*

WILL CONTINUE TO READ IT.

Mankato, Minn., Jan. 13, 1893.

I have received your Journal for some two years and in its new form shall continue to read it.

Truly yours, M. B. Haynes, *City Engineer.*

THINKS IT A GREAT IMPROVEMENT.

Minneapolis, Minn., Jan. 14, 1893.

Your handsome monthly in the new form is received. We think it a great improvement on the old style, and the editorial and contributed articles are interesting and valuable for preservation, and in convenient form for binding. Wishing you a large success, we remain, yours truly,

Parkhurst Paving Co.

BRIEF, BUT GRATIFYING.

Troy, N. Y., Jan. 12, 1893.

We congratulate you.

Ostrander Fire Brick Co.

LIKE ITS NEW STYLE.

Boston, Mass., Jan. 18, 1893.

We are pleased with its "new garments" and typographical arrangement.

Pope Mfg. Co.

WILL BE OF MUCH USE.

Mobile, Ala., Jan. 12, 1893.

It strikes us that you made a great improvement in your magazine and we believe it will be of much use to all parties interested in municipal work.

Yours truly,
Improved Wood Pavement Co.,
By A. C. Danner, *President.*

EVEN THE ADVERTISEMENTS ARE IMPROVED.

Philadelphia, Pa, Jan. 16, 1893.

To say there is a decided improvement in your magazine is putting it very mildly indeed. The specimen cover published in your December issue was evidence to me of a great improvement in form and taste; to me it is very taking. I was not prepared, however, for the improvements in the inside arrangements. Why, everything is improved—even the advertisements. To tell you all I think about it would seem fulsome. I really am much pleased with it and as to suggesting improvements, why, you have not left me an inch of room.

Yours truly, William Waplington.

CALLS THE ATTENTION OF COUNCIL TO IT.

Boone, Iowa, Jan. 16, 1893.

I think it just the kind of periodical needed by parties interested in that kind of work, and shall call the attention of the City Council to the matter at its next meeting. Respectfully,

W. W. Hixon, *City Clerk.*

A GREAT IMPROVEMENT.

New York, Jan. 17, 1893.

New form is great improvement. By judicious selection of best information on construction and maintenance of different kinds of road pavements—Europe is a very important source from which to draw—your paper could become the recognized authority on that subject in America.

Yours truly, Rudolph Hering,
No. 277 Pearl St.

MORE CONVENIENT FOR REFERENCE.

Michigan City, Ind., Jan. 11, 1893.

I like the new form much better than the old as it is more convenient for binding and keeping for future reference. Yours, etc., H. M. Miles,
119 E. 9th St.

ONE OF THE BEST.

Fostoria, Ohio, Jan. 17, 1893.

The magazine needs no suggestions to improve it as it already is one of the best published and the form is the best. Yours very respectfully,

Frank Gebert.

LIKES THE BIOGRAPHIES.

Everett, Mass., Jan. 15, 1893.

I am very much pleased with "Paving and Municipal Engineering" in its new form, especially the short biographies of contributors.

Yours, etc., George L. Mirick.

IN THE LINE OF DUTY EVERY MUNICIPAL OFFICER

Should be a regular reader of PAVING AND MUNICIPAL ENGINEERING. He will learn from it much that he ought to know; much that he can learn in no other. *SEE WHAT SOME OF THEM SAY ABOUT IT.*

INDISPENSABLE TO MUNICIPAL ENGINEERS.

HAMILTON, OHIO, January 23, 1893.

The contents of your magazine are vital subjects that render it indispensable to municipal engineers.
Respectfully,
L. A. DILLON.

OF THE HIGHEST IMPORT TO THE ENGINEERING WORLD.

SACRAMENTO, CAL., January 24, 1893.

PAVING in its new form far excels my greatest anticipations, and I consider its articles of highest import to the engineering world. Your detailed articles are especially of value, noticeably your recent specifications for Brick Paving.

Yours truly,
J. C. BOYD,
City Engineer Sacramento, Cal.

FROM W. C. HOLBROOK, STERLING, ILL.

The best engineering magazine published.

FROM JUSTUS L. EBERHARDT, C. E., WOOSTER, OHIO.

I find PAVING AND MUNICIPAL ENGINEERING very convenient in form and full of good information. I think it is just the book wanted by every engineer.

FROM E. FRANK GATES, CITY ENGINEER AND SURVEYOR, MARIETTA, O.

I have been looking forward to the new form of issue with a great deal of pleasure, and will say that the result has greatly exceeded all expectations. In the short time that I have been a subscriber to your journal I have derived more benefit from it than from all other publications of the like to which I am a subscriber.

FROM BOARD OF DIRECTORS OF THE STREET AND SEWER DEPARTMENT.

WILMINGTON, DEL., January 23, 1893.

We are much pleased with PAVING AND MUNICIPAL ENGINEERING, in its new form, and wish you as much success as you have made improvement (which we consider a great one). Kindly renew our subscription upon the expiration of our present term.
Respectfully, etc.,
HARVEY J. WILEY, Secretary.

SOME OF MANY COMMENTS.

VERY MATERIALLY IMPROVED.

Boston, Mass, Jan. 16, 1893.

I think the change has very materially improved it, and congratulate you upon its improved arrangement and appearance. Yours truly,
C. R. CUTTER.

ALL THAT COULD BE DESIRED.

Buffalo, N. Y., Jan. 11, 1893.

"Paving and Municipal Engineering" appears to me now as about all that could be desired as to form and matter. S. J. Fields,
Chief Engineer Board of Public Works.

A MODEL OF ITS KIND.

Cincinnati, Ohio, Jan. 17, 1893.

We have your January number of "Paving and Municipal Engineering" and think it a model of its kind. We congratulate you on the general appearance of the book and the interesting matter it contains. Wishing you every success in the coming year, we are Yours very truly,
S. J. Osborn, Jr., & Co.

A JOURNAL OF EXPERIENCES AND EXPERIMENTS.

New Haven, Conn., Jan. 16, 1893.

The "Paving and Municipal Engineering" is a good thing, and I like its form and matter. For some time to come it must necessarily be a journal of experiences and experiments. I think Purington has stated the case very fairly.
Yours, S. P. Crafts, *Treas.*
Quinnipiac Brick Co.

INTERESTING AND INSTRUCTIVE.

Pittsburgh, Pa., Jan. 16, 1893.

The January number of "Paving and Municipal Engineering" came to hand a few days ago. We can say that its appearance is pleasing and the matter it contains is interesting and instructive. We bespeak for it increased patronage.
Yours truly, David Carhart,
Dean and Prof. Civil Engineer
Western University of Pa.

PLEASED WITH THE CHANGE.

Kansas City, Mo., Jan. 16, 1893.

The January number of "Paving and Municipal Engineering" in its new form has been improved. I am very much pleased with its change.
Truly yours, G. J. Baer.

DESERVES GENEROUS SUPPORT.

New Harmony, Ind., Jan. 15, 1893.

I am much pleased with its make-up and scope. It certainly ought to receive a generous support from those whom it especially interests.
Yours, etc., John B. Elliott.

PLEASED WITH THE MAKE-UP.

Lockport, N. Y., Jan. 16, 1893.

I am very much pleased with the general make-up and wish you continued success in your enterprise.
Yours truly, Julius Frehsee,
City Surveyor.

CONTENTS VARIED AND INTERESTING.

Haverhill, Mass., Jan. 14, 1893.

"Paving and Municipal Engineering" presents a very creditable appearance and its contents are varied and interesting.
Yours very truly, John T. Desmond.

A GOOD INVESTMENT FOR ENGINEERS.

New Haven, Conn., Jan. 14, 1893.

A good investment for municipal engineers. Contains a great deal of interesting information in convenient shape. A. B. Hill.

THE IMPROVEMENT IS GRAND.

Sterling, Ill., Jan. 14, 1893.

The improvement is grand; so far I see no chance for improvement. Very truly yours,
W. P. Palmer.

FILLS AN IMPORTANT PLACE.

Chamberlin, S. D., Jan. 13, 1893.

"Paving and Municipal Engneering," especially in its new dress, is admirable. It supplies an important place. It should be in the hands of every county and city engineer in the United States. Agitation for improvement in public highways is in the right direction and will result in good. Unlock the stores of knowledge. The world will get the benefit, and gladly fee the turn-key.
Yours, Scott Hayes,
County Surveyor and City Engineer.

MAY BE CALLED PERFECT.

Rochester, N. Y., Jan. 17, 1893.

Your magazine is now so complete that it may be called perfect, and I shall have to be a contributor and reader for a long time before I can suggest any improvements. Very truly yours,
W. Stuart Smith, Jr.

A VALUABLE PUBLICATION.

Toledo, O., Jan. 13, 1893.

We are highly pleased with "Paving and Municipal Engineering" in its present form and consider it a valuable publication.
Yours truly, Massillon Bridge Co.

EVERY CITY ENGINEER SHOULD HAVE IT.

Columbus, O., Jan. 13, 1893.

"Paving and Municipal Engineering" is great. It should be in the hands of every city engineer in the United States. It would prove a great educator. Yours, F. M. Senter, *Clerk B. P. W.*

VERY WELL PLEASED WITH IT.

Alliance, O., Jan. 14, 1893.

I am very much pleased with it in its new form.
George R. Gyger.

A VERY CREDITABLE MAGAZINE.

Denver, Colo., Jan. 13, 1893.

Your new style is a great improvement and it makes a very creditable magazine.
Yours, F. J. Warren.

VALUABLE TO THE ENGINEERS AND CITIZENS.

Memphis, Tenn., Jan. 14, 1893.

I think the change a great improvement, and further, I regard the magazine as of great value to the municipal engineer in especial, and the citizen in general, who feels an interest in the advancement of all municipal matters and the public ways of the country. Niles Merriwether, *City Engineer.*

IT MUST BE APPRECIATED.

Altoona, Pa., Jan 13, 1893.

Your magazine in its new form is much improved in appearance. It is always interesting and if the January number is a fair sample of what we are to expect in the future, it must be appreciated.
Yours truly, Harvey Linton.

PROGRESSIVE AND PROSPEROUS.

[Columbia College] New York, Jan. 13, 1893.

I am glad to see your progressiveness and the sure signs of prosperity. Yours, H. C. Bowen.

EVERY CITY OFFICIAL SHOULD HAVE IT.

Omaha, Neb., Jan. 14, 1893.

I am much pleased with "Paving and Municipal Engineering" and think every city official should possess it. John Groves, *City Clerk.*

PAVING.

Sealed proposals will be received at the office of the city clerk, of the city of Canton, Illinois, until 12 o'clock noon of the 21st day of February, 1893, for grading, curbing and paving the following streets with brick, in accordance with the plans and specifications on file in the city clerk's office, approximately as follows:

No. 1. The public square, 9,805 square yards brick paving, 1,800 cubic yards excavation, 863 lineal feet stone curbing. Bond, $5,000.

No. 2. South Main street from Elm street to Walnut, 8,600 square yards brick paving, 700 cubic yards excavation, 1,600 lineal feet stone curbing. Distance, 829 feet, width, 39 feet. Bond, $2,000.

No. 3. South Main street from Walnut street to Linn, 8,250 square yards brick paving, 1,875 cubic yards excavation, 4,650 lineal feet stone curbing. Distance, 2,569 feet, width, 30 feet. Bond, $4,000.

No. 4. East Maple street from Main street to Fourth avenue, 5,700 square yards brick paving, 1,200 cubic yards excavation, 3,200 lineal feet stone curbing. Distance, 1,700 feet, width, 30 feet. Bond, $2,000.

No. 5. South Second avenue from Elm to Oak street, 7,200 square yards brick paving, 1,700 cubic yards excavation, 4,050 lineal feet stone curbing. Distance, 2,140 feet, width, 30 feet. Bond, $2,000.

No. 6. East Chestnut street from East side of public square to Second avenue, 3,000 square yards brick paving, 600 cubic yards excavation, 1,200 lineal feet stone curbing. Distance, 566 feet, width, 38 feet. Bond, $2,000.

No. 7. First avenue from Chestnut to Pine street, 3,800 square yards brick paving, 700 cubic yards excavation, 1,600 lineal feet stone curbing. Distance 750 feet, width 39 feet. Bond, $2,000.

No. 8. Elm street from east side public square to east line Second avenue, 3,100 square yards brick paving, 600 cubic yards excavation, 1,100 lineal feet stone curbing. Distance 700 feet, width 39 feet. Bond, $2,000.

No. 9. West Elm street from Avenue A to public square, 1.700 square yards brick paving, 350 cubic yards excavation, 800 lineal feet stone curbing. Distance 377 feet, width 40 feet. Bond, $2,000.

No. 10. West Chestnut street from Avenue A to public square, 1,780 square yards brick paving, 375 cubic yards excavation, 800 lineal feet stone curbing. Distance 376 feet, width 42 feet. Bond, $2,000.

No. 11. North Maine street from public square to Locust street, 2,500 square yards brick paving, 500 cubic yards excavation, 750 lineal feet stone curbing. Distance 375 feet, width 60 feet. Bond, $2,000.

Proposals must be made on blank forms furnished by the city clerk.

Specifications furnished upon application to the city clerk.

The whole of the work to be completed on or before August 1, 1893.

The city reserves the right to reject any or all bids.

By order of the city council of the city of Canton, Illinois.

Dated at Canton, Illinois, this 24th day of January, 1893.

[Signed] J. C. THOMPSON, JR., City Clerk.

PAVING.

Sealed bids will be received in my office, in the City Hall building, up to 5 o'clock p. m., of the 22d day of February, 1893, for the grading and paving, with standard paving brick, the road-way of Jackson street from the East line of Second street to the West rail of the C., C., C. & St. L. Railway Company's track, to be built in accordance with the ordinance passed for the same, and the plans and specifications now on file in my office. Each bid shall be made per square yard for pavement complete, and per running foot for curbing.

Each bid shall be accompanied by a certified check of one hundred dollars, payable to P. P. Able, City Treasurer, to be returned to all unsuccessful bidders, and to be returned to the successful bidder, if he shall, within ten days after the contract is awarded to him, enter into a written contract with the City of Elkhart for the faithful performance of said work.

The costs of said pavement shall be assessed, collected and paid in accordance with Sections 812, 813, 814, 815, 816, 817, 818, 819, 820 and 821 of Elliott's Supplement so far as they are applicable, and as they now exist, and as amended by Sections 1, 2, 3, 4 and 5 of Chapter CXVIII of the Acts of 1891.

The City of Elkhart reserves the right to reject any and all bids.

CHAS. L. KINNEY,
City Engineer.

PAVING.

Sealed bids will be received in my office, in the City Hall building, up to 5 o'clock P. M., of the 22d day of February, 1893, for the grading and paving, with standard paving brick, the roadway of Second street, from the south line of Tyler avenue to the south line of Water street, and the roadways of Tyler avenue, Harrison street, Marion street, Franklin street, High street, and Pigeon street, between the west line of Main street and east line of Second street, all in the city of Elkhart. To be built in accordance with the ordinance passed for the same, and the plans and specifications now on file in my office. Each bid shall be made per square yard for pavement complete, and per running foot for curbing.

Each bid shall be accompanied by a certified check of one hundred dollars, payable to P. P. Able. city treasurer, to be returned to all unsuccessful bidders and to be returned to the successful bidder, if he shall, within ten days after the contract is awarded him enter into a written contract with the city of Elkhart for the faithful performance of said work.

The costs of said pavement shall be assessed, collected and paid in accordance with sections 812, 813, 814, 815, 816, 817, 818, 819, 820 and 821 of Elliott's Supplement so far as they are applicable, and as they now exist, and as amended by sections 1, 2, 3, 4 and 5 of Chapter CXVIII of the Acts of 1891.

The city of Elkhart reserves the right to reject any and all bids.

CHAS. L. KINNEY,
City Engineer.

H. H. WAINWRIGHT,
PATENTEE.

... THE ...

ANCHOR ARTIFICIAL CURB.

IRON-BOUND AND

NON-BREAKABLE.

PATENTED MAY 20, 1890.

Especially Adapted for Streets, Wharves, Railroad Depots, Piers, Roadways of Bridges, Market Houses, Breweries, Warehouses, Etc.

ITS ADVANTAGES ARE

Greatly reduced cost as compared with Granite Curbing, which it will, in time, entirely supplant, as it is superior in appearance and finish.

It is provided on the outside edge with an iron plate, which strengthens as well as protects it from wear, and breaking from contact with cart or wagon wheels, or other causes of injury. This plate, being galvanized, does not discolor the face of the curb.

In addition to this, two bars of angle iron form the front and back of the bottom of the curb, making it **Iron Bound** on THREE corners, and tie rods are imbedded in the concrete for its entire length, giving it strength equal to granite, and making it absolutely **non-breakable.**

This curb is continuous throughout its entire length, and has no joints to separate and get out of position, as the short lengths now used of the ordinary stone invariably do, after a few years of use.

Although lighter, and containing less material than the heavy stones now used, it has a strong iron frame, resting on foundation pieces, which are buried deeper than the curbstones now in use, and provided with **Anchor Plates,** which make it immovable under any circumstances.

While it is an ornamental improvement to private dwellings, it is of great value in such places as the yards of breweries, and the vicinity of market-houses, warehouses, etc., where heavy wagons are continually backing up to receive or discharge their loads.

For railroad depots, wharves, piers and shipping docks, also driveways for bridges, it will prove of great benefit, and will outlast any other kind of Curbing that could be used.

The COMMERCIAL VALUE of the Anchor Iron-Bound Curb is in the fact that it can be laid at a much lower cost than Granite curbing and pay a profit of about 50 per cent.

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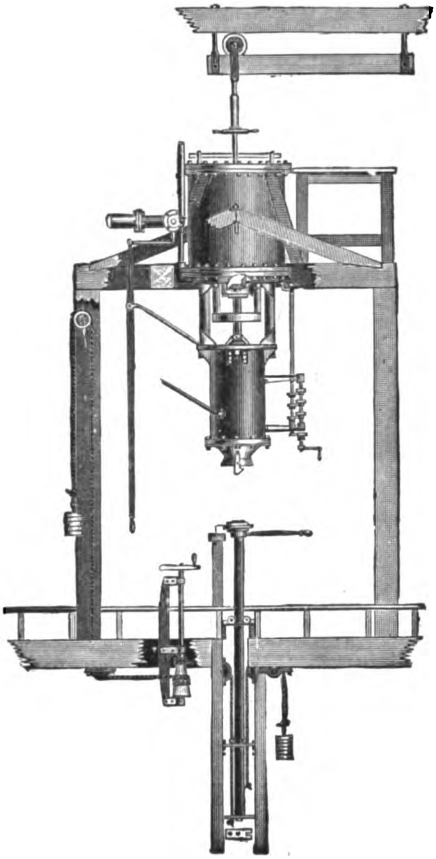

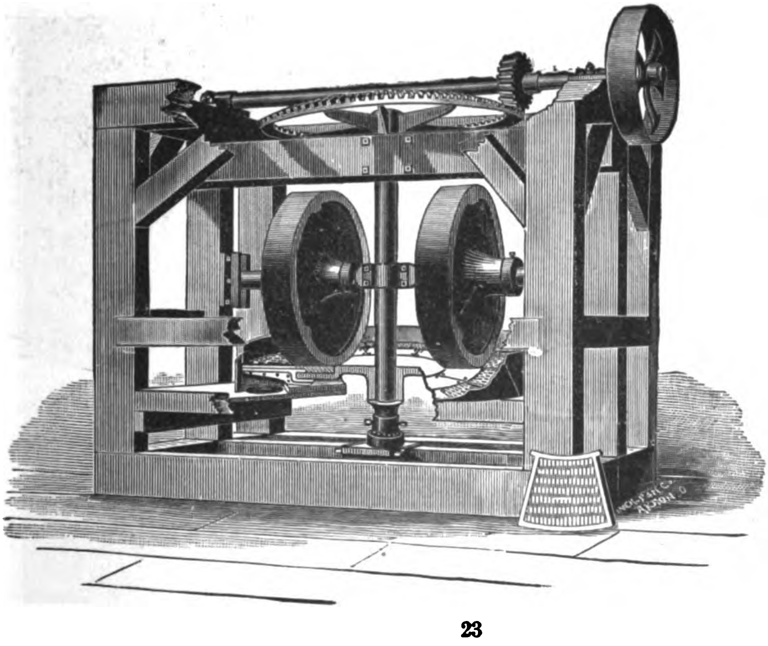

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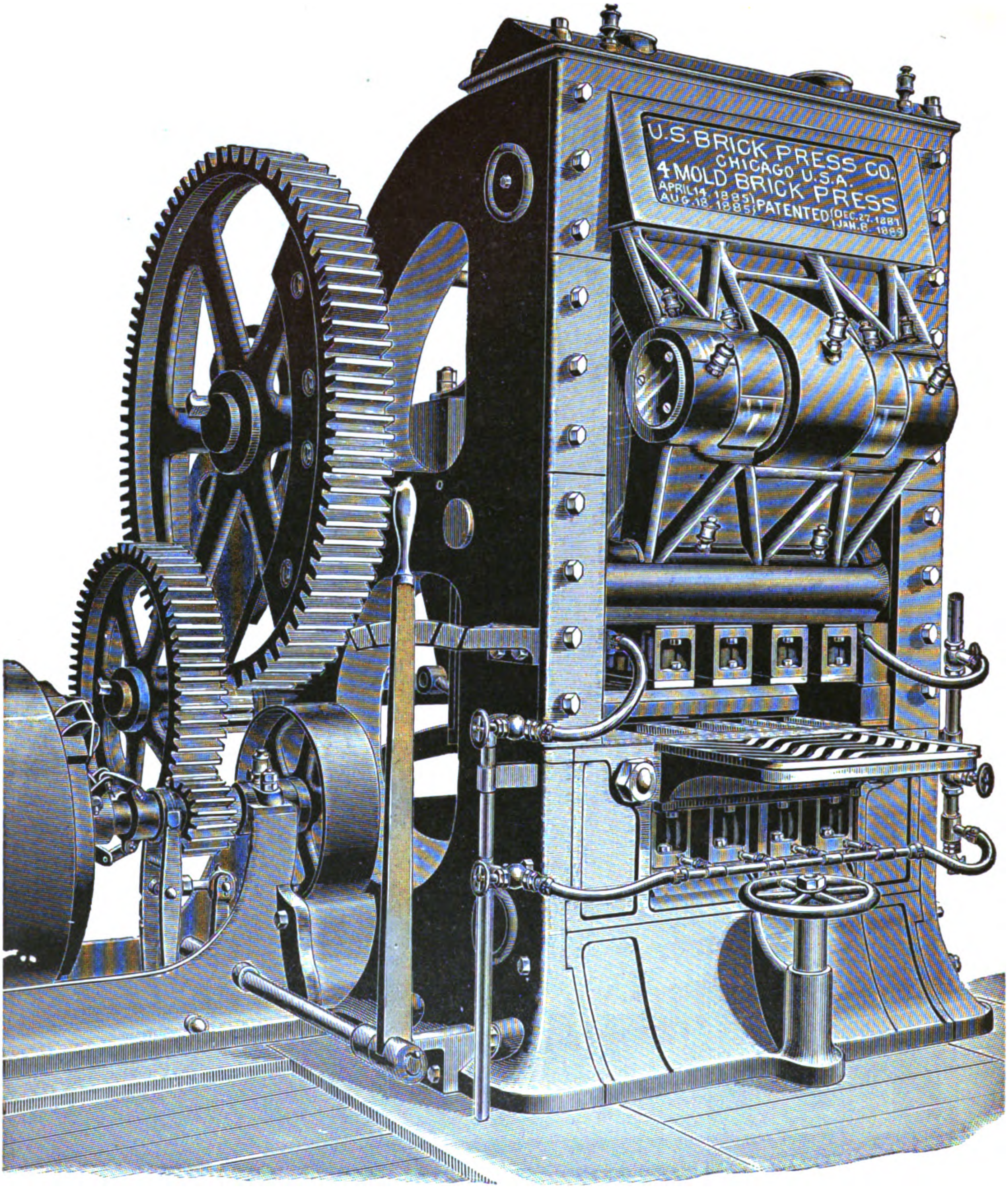

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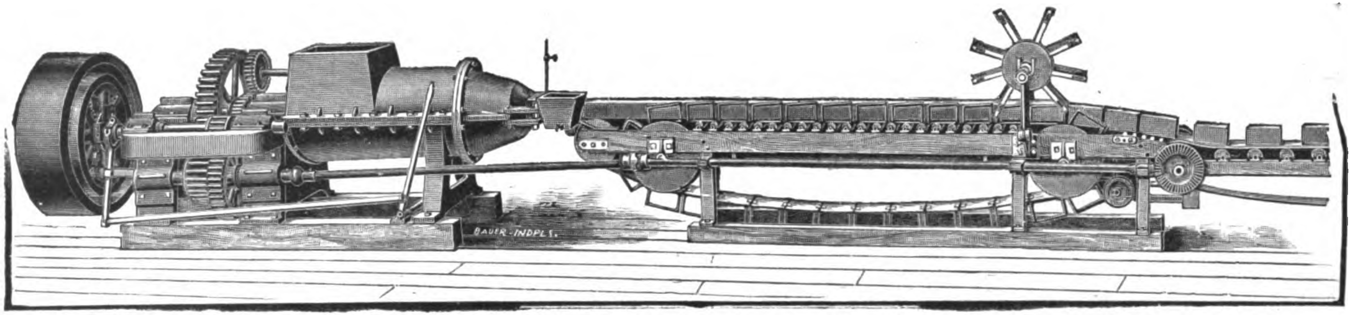

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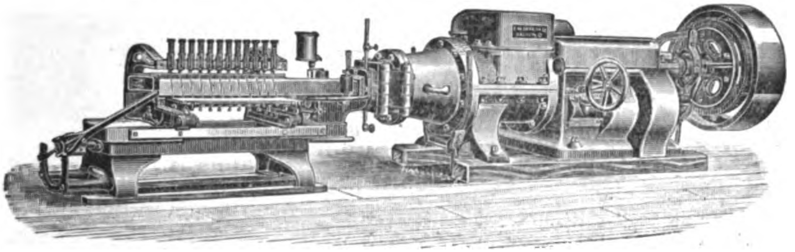

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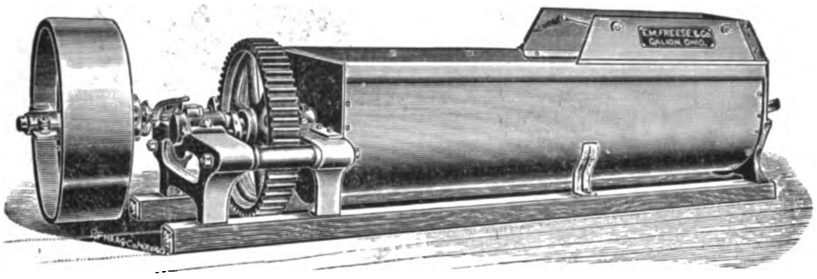
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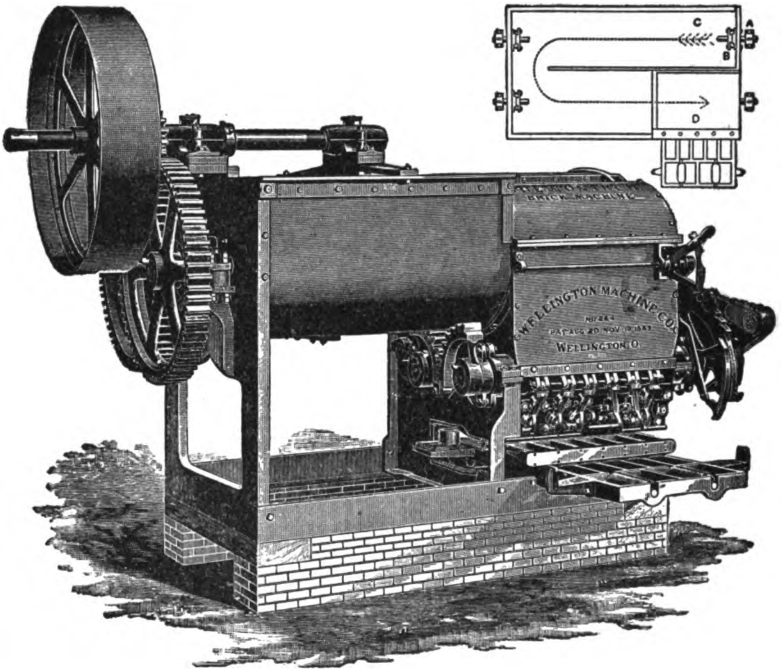

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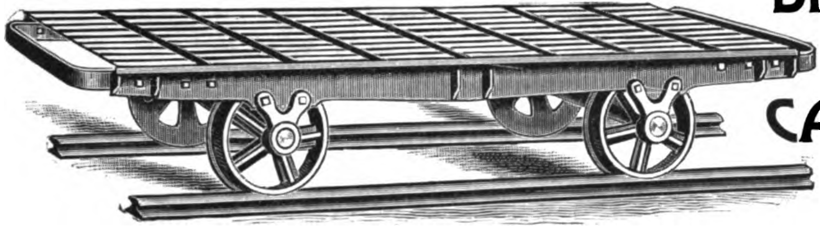

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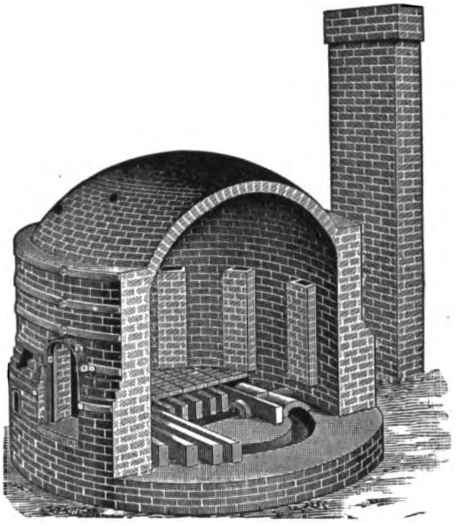

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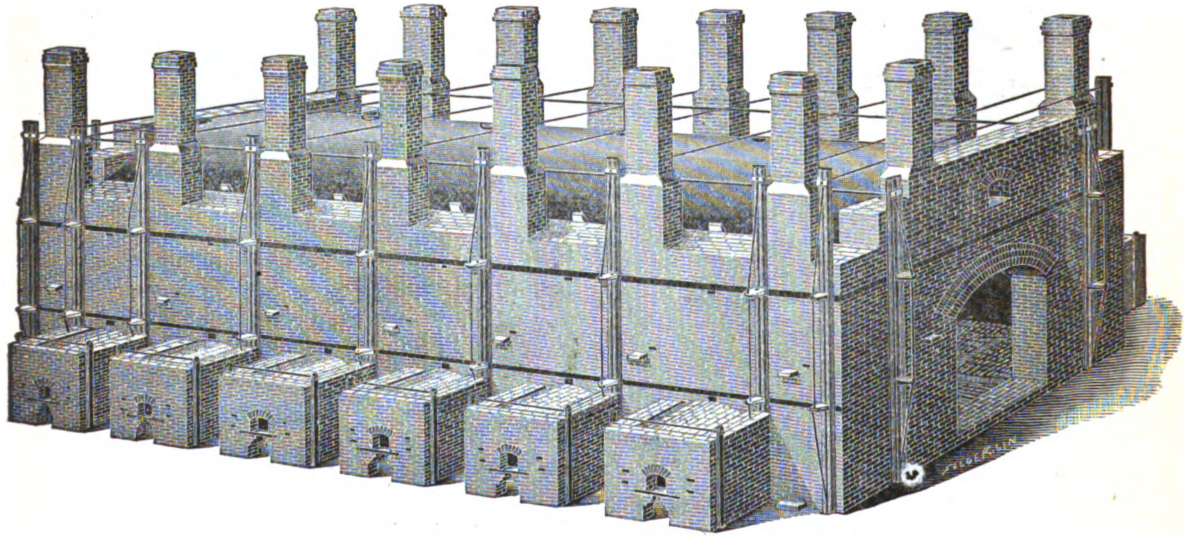

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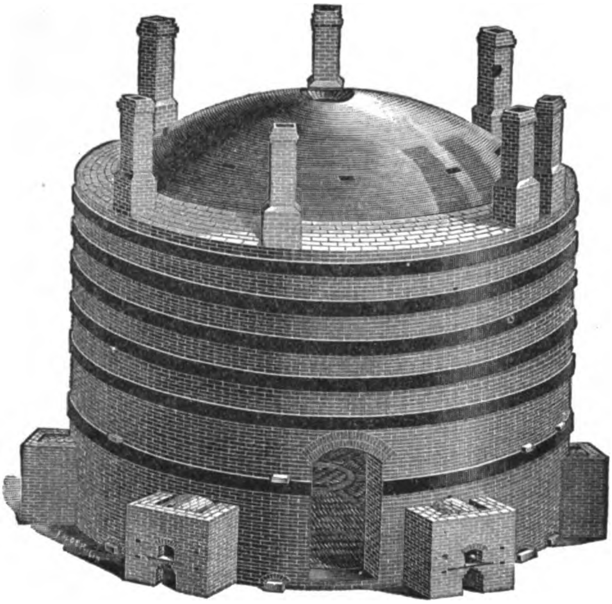

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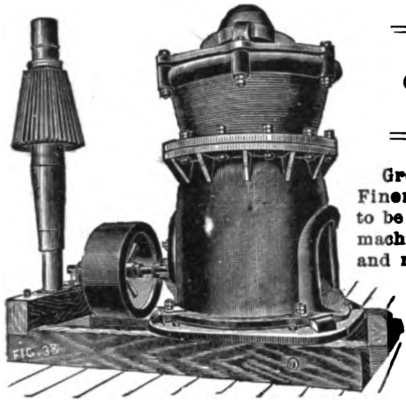

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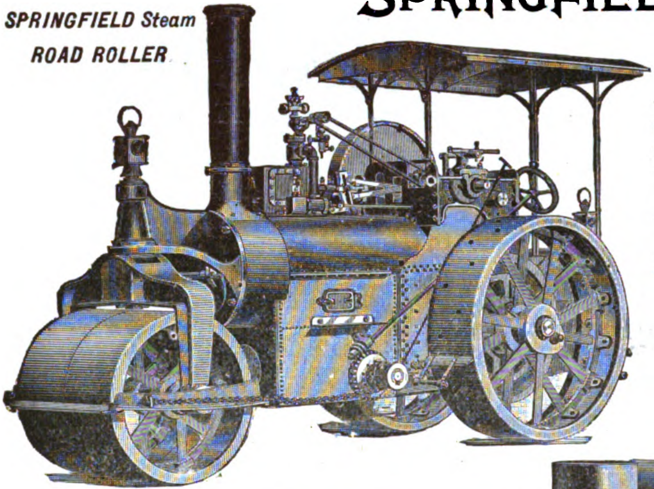

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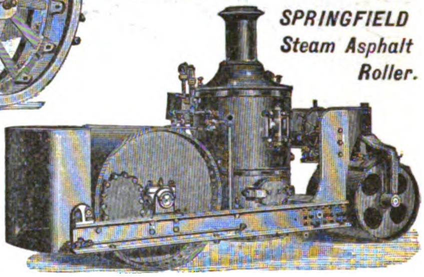

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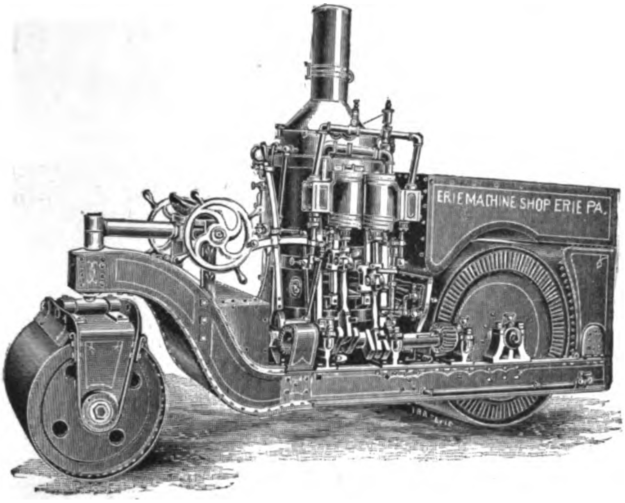
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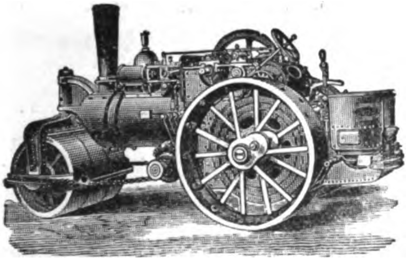

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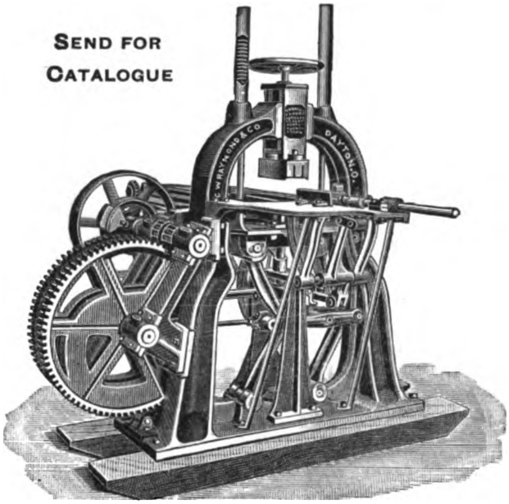

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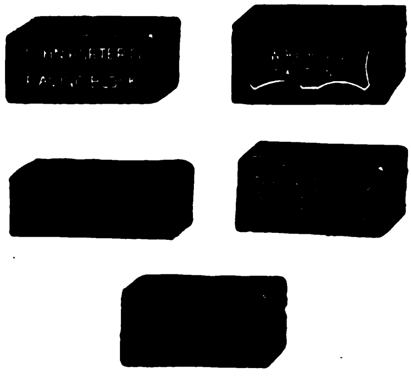

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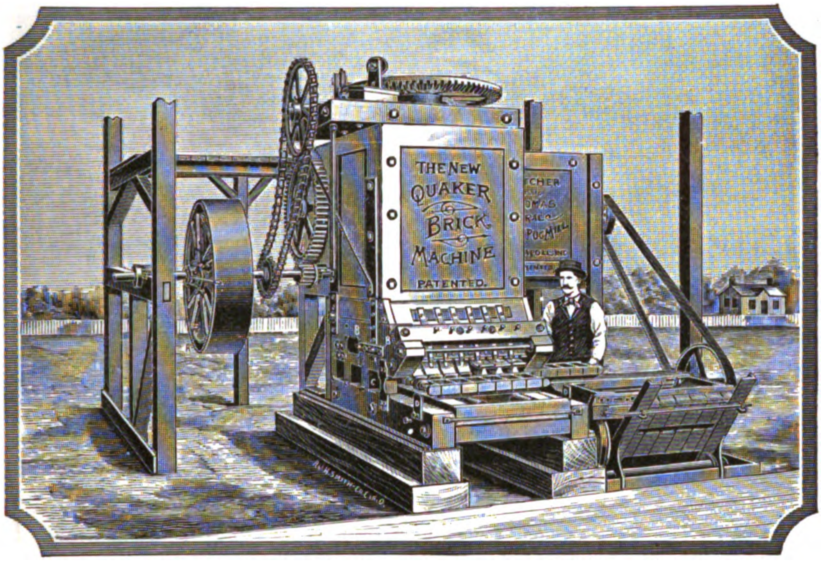
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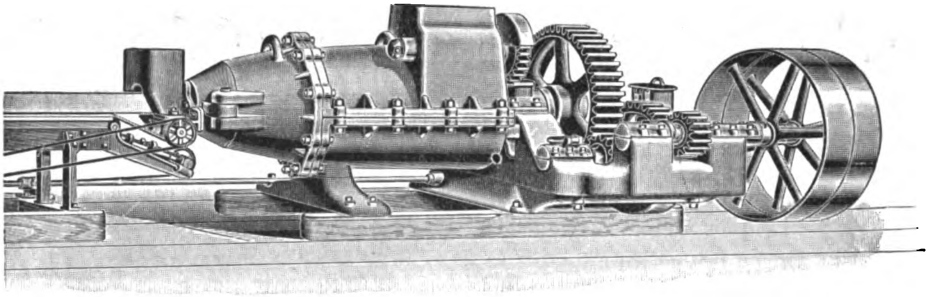

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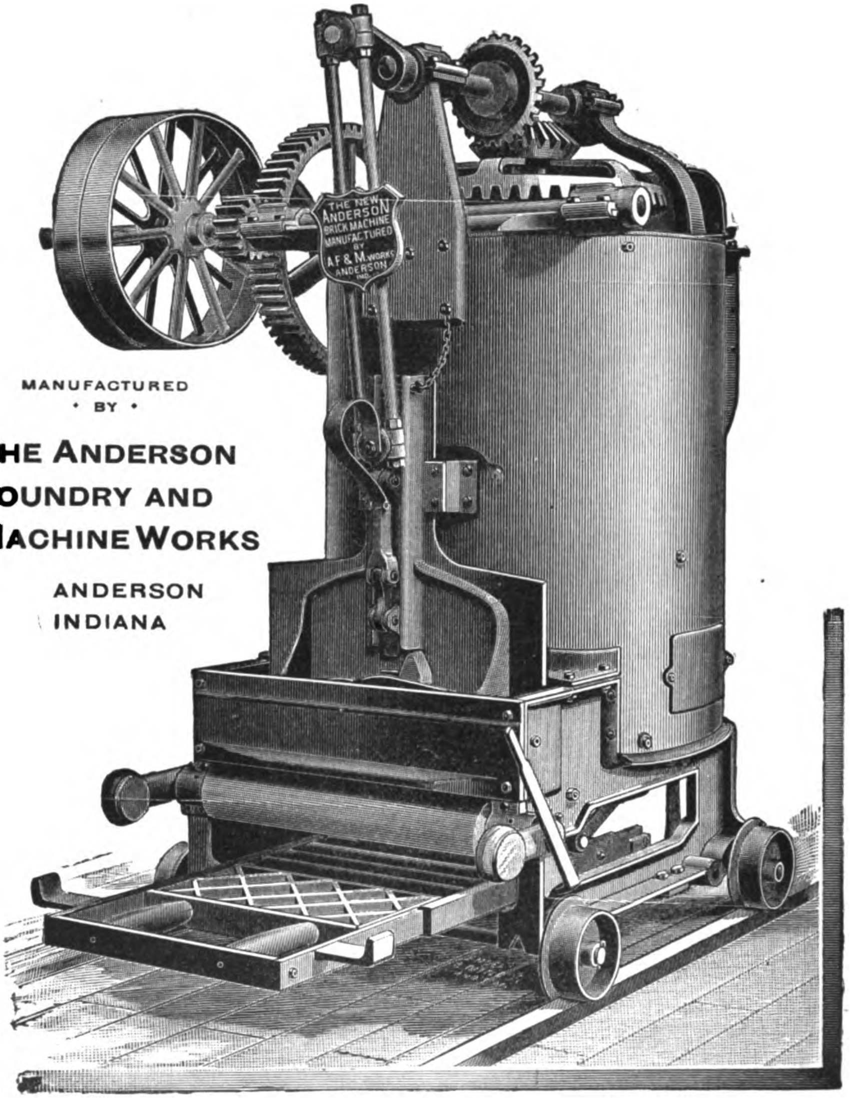
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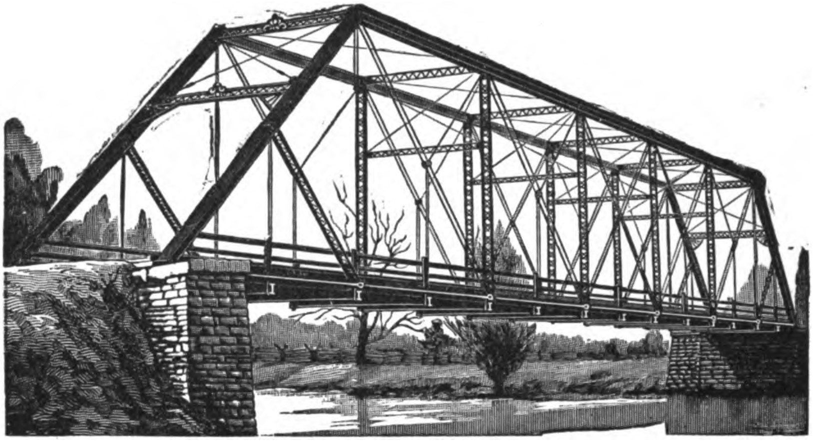

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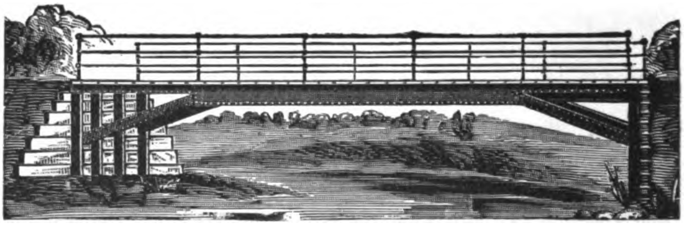

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ALL THAT COULD BE EXPECTED.

WILLOUGHBY, O., Jan. 14, 1893.

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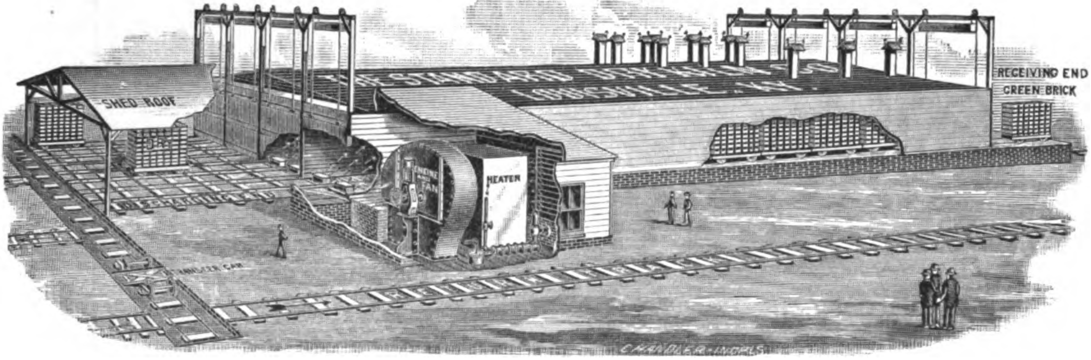

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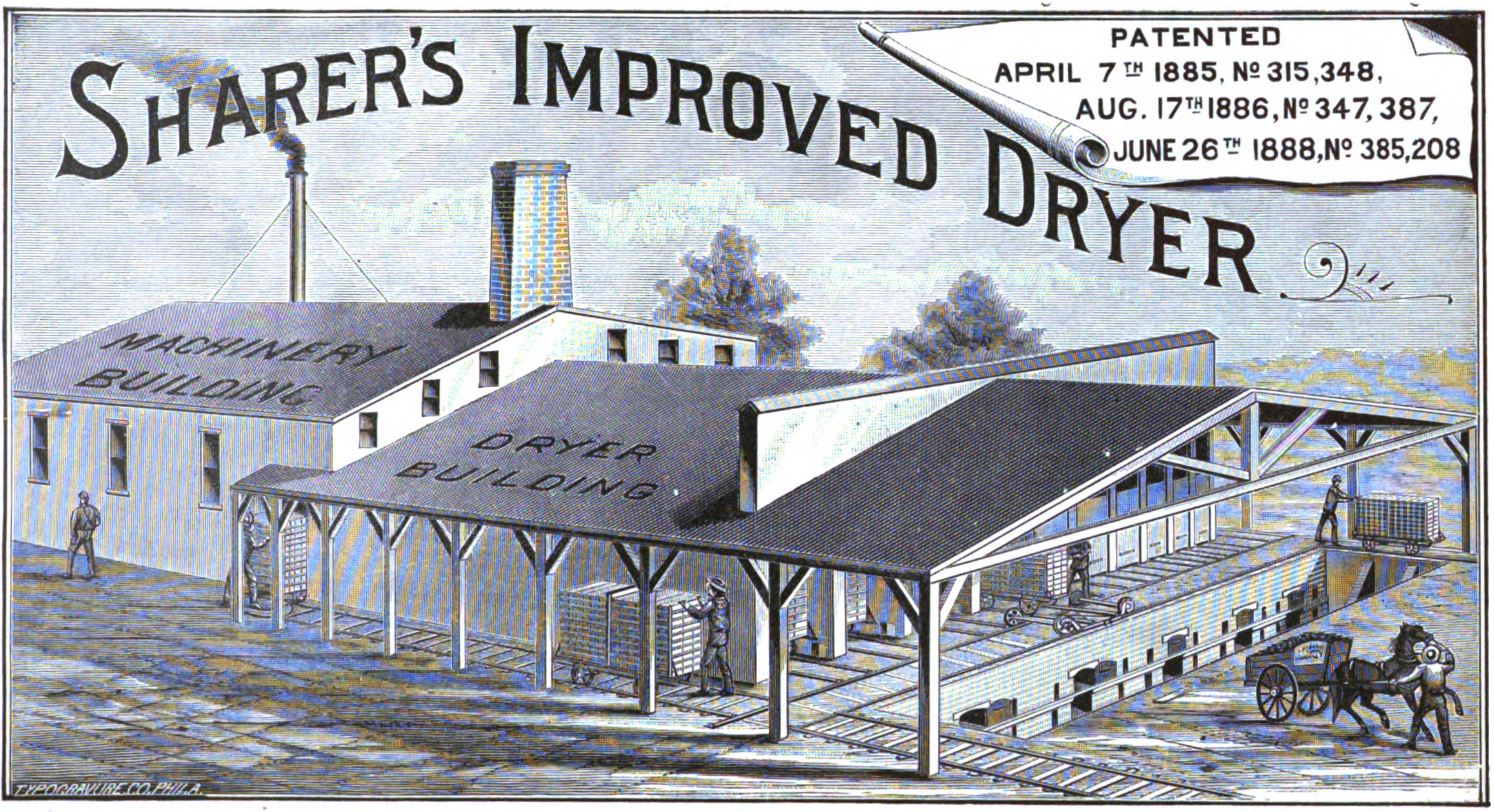

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Are Asphalt Pavements Durable?

SOME ADDITIONAL FACTS.

No good Trinidad Asphalt pavement in this country has yet been worn out, consequently we have no reliable data as to their actual endurance. A very few pavements have failed because of defective material or want of skill in laying them, but nearly all the Trinidad Asphalt pavements that have been laid in this country are still in good condition.

The first street of any importance in this country paved with asphalt was Pennsylvania Avenue, Washington, D. C. This pavement was completed in the summer of 1876. In 1889, after thirteen years' use on the heaviest traveled street in Washington, the pavement was found to have lost very little, if any, of its thickness, by wear, but, owing to a slight defect in the composition, the surface had become so uneven or wave-like that it was thought best to resurface it. But for this defect this original pavement would doubtless have been still in use and in good condition.

All pavements subjected to very heavy travel wear out in time. Neither granite nor steel can withstand the abrading effect of travel such as some streets are subjected to; but experience has proven that a good asphalt pavement has qualities of endurance second only to granite.

Paving and Municipal Engineering

VOLUME IV. MARCH, EIGHTEEN NINETY-THREE. NUMBER 3.

MUNICIPAL EQUIPMENT AND ENGINEERING OF PARIS.*

III.

THE ADMINISTRATION OF PUBLIC WORKS.

THE transformation of the French capital from narrow streets, bad water and poor drainage, into modern Paris, with its handsome avenues, good water and complete drainage, is due to the plan of organization and the administration of its department of public works, more than to the financial resources of the city. Several other cities have had, and now have, greater financial strength; but because of the lack of a properly organized administration of public works, added to the fact that trained and able men are seldom selected and given permanent positions, such cities produce but few economical, homogeneous and lasting improvements.

The Americans insist upon a careful organization and a trained *personnel* in private enterprises of great magnitude. Shall we not insist upon an equal equipment for that most important of all enterprises, namely, the administration of a *city*, entrusted with the moral and material welfare of human beings.

Paris insists that the health and prosperity of its citizens depend more upon the department of public works than upon any one other branch of the city government. The appointment to positions in this department depends first upon the technical or other suitable education. Promotion is never lost sight of, and it depends upon seniority, coupled with technical and executive ability. The hope and possibility of promotion is the secret of success of much of the

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municipal work in European cities. Remove this hope and supply its place with political influence, and—we have too many examples of the results.

The magnitude of the improvements at Paris made since 1852 can be judged from the fact that upon the one work of opening new streets and avenues and widening old ones Paris has spent 1,202,000,000 francs ($240,400,000). One of the noblest and ablest engineers the world has ever seen was connected for forty years with these vast undertakings. At his death, two years ago, all Paris was in mourning. His name is Monsieur Jean C. A. Alphand. A brief outline of his life forms the best introduction I can present to the subject of the public works of Paris. Having reviewed the organization of this department, we can better study in subsequent articles the details of water-works, sewers, pavements, etc., each administered by a special division of the department. All are interlaced but not complicated with the other divisions. The co-operation of the different divisions conduces to better success. It has been my experience to see a lack of co-operation in some cities between the water, sewer and paving departments, resulting in wasted energy, time and money as well as poor results.

Monsieur Alphand at seventy-one years of age, when I last saw him, was erect, energetic, active and full of business. He was a privileged official, admired and loved by all. He had no enemies and his only opponents were a few members of the city council, opposing some of his proposed millions for improvements. Even these reproached him admiringly for working too hard and for having concentrated so many powers in one person.

Paris honors him for the plans which he drew up at thirty-six years of age in 1854 according to which the city has been reconstructed.

He is admired for his second plan for the enlargement of the city, as well as for executive work throughout the forty years of his public service.

The broad avenues cut directly through the blocks of houses, and the arrangement of the streets of the new sections are lasting monuments to M. Alphand and his able assistants.

All work executed at Paris during the last forty years was more or less planned, studied, prepared or directed by this remarkable man, whose history is now being written in French, and remains to be undertaken in English.

His father was a colonel in the army of Napoleon I. He graduated from the *Ecole des Ponts et Chaussees*, the chief civil engineering school of France, and after working at railway construction and road building in central France, he became known for the construction of a difficult deep water quay. He also showed ability as an organizer of public celebrations.

When called to Paris, his first duty was in charge of public gardens, parks or promenades. He did well and became popular, for Parisians spend most of their leisure time, day or evening, out of doors. He laid out the grand suburban parks; the Bois de Boulogne in 1854–8, Park Moncean in 1861, Bois de Vincennes in 1861–4, Buttes-Chaumont in 1869–70 and Montsouris 1869–70.

He parked several boulevards, including the avenue of the Bois de Boulogne leading to the principal park of Paris, a popular drive, frequented by all visitors who desire to see *le grand monde* of Paris and their equipages. M. Alphand helped construct Boulevard Voltaire, cut through the dense masses of houses. He planned and reconstructed the Moncean quarter, where narrow, crooked streets, and darkness day and night, did much moral and material harm. Straight, broad streets admit air and light, and drive out much that injures property as well as persons.

All this cost millions, many millions. But M. Alphand spent his portions honestly and well. Never has he been even suspected of gaining more than honor, public thanks and his moderate salary. M. Alphand, notwithstanding his technical education, loved fine art, and often insisted upon expensive embellishments of fountains, statuary and paintings in connection with the streets, parks, bridges and buildings constructed by the city. These enormous expenditures for art in connection with practical public works make Paris far pleasanter for those living there. At the same time these and other attractive features of the productions of M. Alphand cause thousands of foreigners to choose Paris as their abiding place, having retired from the pursuit of gain in their own lands. These and the million visitors each year to Paris more than repay the interest on the loans required to accomplish these works.

It is pleasant to remark that our capital, Washington, with its fine buildings, pleasant squares and parks, and quiet, clean asphalt streets, attracts many retired successful men to it, to live there and enjoy those things which many other cities have not the foresight to provide.

The prosperity of many a city ceases in proportion as it fails to retain its prosperous retired merchants and the income derived from their capital.

One of the noblest and best things which M. Alphand did was to always sustain and defend his trained and trusted assistants, from the highest engineer to the humblest clerk. His whole department therefore acted as a unit and was always true to its chief. All business was carefully classified and assigned to the proper division and that division held strictly responsible for the results.

After the commune of 1871 had blocked so many streets with paving stone and other barriers, as soon as peace was established, M. Alphand within a very few weeks made all the streets available for use.

In 1878 all the branches of public works were concentrated in his hands.

In 1878 he designed the garden of the Trocadero.

In 1889 he became the director of construction of the Exposition, continuing his duties as the head of the public works of the city.

M. Alphand avoided politics, as every city engineer should, and thus induced politics to let him alone. He declared that his politics were to make Paris agreeable, beautiful and healthful.

The department of public works, which he reorganized and managed so long, is now in excellent condition and well administered by his successor.

This is all the more possible because of the complete and well indexed records which M. Alphand, like other able engineers, insisted upon being kept for the benefit of his co-workers and successors.

The department of public works has charge of all construction within Paris, the water supply and the sewers and canals of Paris. It governs and inspects all private construction.

The employes are divided into two categories:

First. The bureau or indoor service, which keeps records of all correspondence, maps, plans, scientific and engineering statistics, estimates of costs.

Second. The executive, called the active or exterior service, which plans, executes and inspects the works of the department. The highest official is the "Director of Public Works of Paris," next comes the sub-director, who is his deputy or vice-director; then comes a very important official, liked and admired by all. He is the private secretary of the director, modest and able. He suppresses his own name, but because of his splendid education and long experience he is of great value to the city. He does all in the name of the director. It was my pleasure to be his guest last summer. No man could have been more polite, attentive and aided another more than this estimable gentleman does those who are presented to him.

THE BUREAU SERVICE is organized as follows: The director is in general charge. The sub-director next. Both are aided by the private secretary of the director. We would call him chief clerk of the department of works. Then come four divisions.

FIRST DIVISION subdivided into *Bureau No. 1*, for general matters and questions concerning the employes of the service. *Bureau No. 2*, recording the matters of the water supply, canals and sewers.

SECOND DIVISION embraces the public thoroughfares by all upon or along them. It has *Bureau No. 1*, for the acquisition of property by purchase, by agreement, or process of condemnation. *Bureau No. 2*, establishment of building lines, etc., sanitary construction of buildings. *Bureau No. 3*, pavements, etc., roadways, sidewalks, and lighting of the streets.

THIRD DIVISION concerns architecture. The sub-director acts as chief of this division, in addition to his general duties. He has also many other special duties, such as the collection of the plans and models of the whole department; direction of the municipal observatory; inspection of the Paris telephone service; inspection of the pneumatic clocks, and compressed air power companies. The Third Division has three Bureaus. *Bureau No. 1*, concerns the architectural works of the municipality proper. *Bureau No. 2*, architectural works done on account of France or the Department of the Seine, but within the limits of Paris. *Bureau No. 3*, for public architectural accounts and examinations, and permits of all proposed public and private buildings and other visible constructions.

FOURTH DIVISION—Fine Arts of Historical Work. *Bureau No.*

1, for the record and supervision of all fine art enterprises of Paris, including instruction, competitions, exhibitions, public celebrations, preservation of the works of art in the gardens, streets and buildings. *Bureau No. 2*, cares for the works of writings concerning the history of Paris, encouraging new discoveries and writings upon that subject.

The bureau service constantly calls in the engineers of the active or exterior service for information and consultation.

The Council of Engineers, presided over by the chief mayor (prefect) of Paris, or, in his absence, by the director of public works, meets once a week. All important proposed improvements, especially those requiring the co-operation of several divisions of the active service are there considered. This council is one of the ablest engineering bodies in the world. It is composed of heads of divisions and others as follows: The prefect and his general secretary, the director, a consulting engineer, the chief engineers of the streets and parks, the chief engineer of the department of the Seine, the chief engineer of the city quarries, the chief engineer of the water-works and sewers. An able assistant engineer is the secretary of this council. Other engineers of all grades can attend these meetings to listen or speak, as the public service may warrant. These latter, however, do not vote. But they certainly are much encouraged by the fact that they are recognized, and at times asked to describe the projects they have in hand, or are about to undertake. This council of engineers belongs rather to the constructing branch, which I will now outline.

The active or exterior service is the branch which plans and executes public work. It is also under the director and sub-director. There are six divisions:

DIVISION A—Public thoroughfares and promenades. It is divided into *Section 1*, for city maps and the study of where extensions or widening of old streets and the establishment of new streets are needed. *Section 2* has, first, a sub-section which decides upon and executes in detail alterations and widening of old streets and cutting through or construction of new streets. Secondly, a sub-section for building permits and inspection, numbering of houses and naming of streets. Thirdly, a sub-section of sanitary engineers, who devise means and methods of sanitary equipment and cleanliness of all portions of private and public property, establishing the sanitary regulations of Paris. *Section 3*, supervision of public vehicles of all kinds, including horse-cars, omnibuses, public carriages, drays, etc. *Section 4*, paths, trees, flowers, etc., of the squares, promenades, parked avenues and parks. *Section 5*, pavements of roadways and sidewalks of the city and its parks, street cleaning and lighting, temporary or permanent use of portions of the sidewalks and roadways. The subject of pavements is so important that the city is divided into two equal sections, and a chief engineer of the highest grade put in charge of each. They are aided by two sets of assistant engineers, who attend to details. *Section 6*, inspection of gas, gas meters and electric lighting.

DIVISION B—Water Supply. *Section 1*, care of municipal canals, care of sources of water supply. *Section 2*, maintenance of aqueducts to the city. *Section 3*, distribution of water. *Section 4*, maintenance of machinery.

DIVISION C—Sewers. *Section 1*, house sewerage. *Section 2*, construction and cleaning of sewers. *Section 3*, irrigation of farm lands with sewage.

DIVISION D—Administering and mapping the quarries under the city, supervising foundations of buildings. It is interesting to know that a little more than 10 per cent. of Paris is undermined by these quarries of building stone.

MAJ. J. W. HOWARD, B. L., C. E.

See biographical sketch in January number, 1893, page 6.

DIVISION E—Architecture. *Section* 1, administration and inspection. *Section 2*, construction and maintenance of the municipal buildings, schools, markets, abbatoirs, cemeteries, etc.; also the inspection and approval of certain classes of private buildings.

DIVISION F—Of fine arts and historical productions and discoveries concerning Paris.

This finishes the outline of the organization of one of the most efficient engineering departments the world has ever seen. When properly studied it suggests many valuable thoughts to every student of political science. Judged by its fruits it is well worth our attention.

J. W. Howard.

NOTES ON SEWAGE AND SEWERS.

THE disposal of sewage has called for a display of the highest grade of engineering skill. The thickly populated countries of the old world have found it necessary to refrain from polluting the streams. With this object in view, various plans have been devised, looking to the disposal of sewage matter; viz.: mechanical and chemical precipitation, filtration and irrigation. There are various mechanical devices in practical use, having in view mechanical precipitation. First. Flat basins filled with sewage and allowed to stand until precipitation is complete. This plan involves different sets of tanks, so that they may be intermittently filled and discharged. Second. Long basins through which the sewage flows slowly. Any of the basins may be cut out for cleaning, but the motion is constant. This plan is designated as continuous precipitation. Third. Upright tanks through which the sewage rises slowly.

The sludge or settlings is not always removed after each precipitation. It may be allowed to accumulate. The arrangement of the settling chambers and the devices employed for cleaning them are various, ingenious and extensive, and there are many of them, which, combined with the chemical plan of precipitation, have worked very successfully. The sludge is generally removed when it is sufficiently wet to admit of its being drawn out through suction pipes.

Lime and sulphate of alumina are used both separately and together as agents of chemical precipitation. Other materials are occasionaly used in combination. The mixing is done by either passing the entire body through a pipe, or by means of a flutter wheel; occasionally the chemicals are forced through a perforated pipe. The amount of precipitates to be used depends on the character of the sewage. That, of course, is dependent upon the judgment of those in charge. The separation of solid material from sewage by filtration is a well understood process. The operation of filtering is necessarily intermittent. Filtering material may be of sand, sod, earth, brick, quarry spalls or other porous material. Straw, grass and other similar substances are sometimes used. The work of filtration must be intermittent for the reason that it is desirable that the air pass through the separated material from time to time. The plans of arrangement are so ingenious and complete, that detailed descriptions can not be given here. Under all these plans it is contemplated that the material removed be used as fertilizer.

Irrigation with sewage seeks to make direct use of the fertilizing material on what is known as sewer farms. The plans of operation vary in detail, though the general idea is the same. It is intended to intermittently discharge the matter over the surface of the field, and to then under-drain the soil so that the water may be drawn off and run into the streams after having passed through a section of the soil. Thus we have the principle of filtration, and aeration used to separate the organic material, and to purify the water which is discharged. One feature which would prevent the general use of the irrigating system in our own country, would be the relatively small demand for fertilizing material, and the large areas required to be covered. A city like New York or Boston would require an area of sewage farms quite as large as the city itself. Until arrangements can be made to run sewers well into the country, and to discharge the material over large areas, it need not be expected that this plan would be generally successful in this part of the world. The large rainfalls which come to us would also be in the way of its adoption. The plan having one system of sewers for storm water and another for house drains, would admit of greatly simplifying the question of the disposal of sewage.

* * *

A new system of sewer construction has come into use during recent years in France and Germany. It is known as the Monier system. It is intended to do away with the use of brick, stone or other similar material. A thin wall and surrounding of concrete, filled in with wire and light metal are used in lieu thereof. The excavation is made in the usual manner, then a frame work of heavy wire is constructed so that the meshes are from two to four inches in diameter To this is fitted the concrete coating, which is put on in the form of a wall entirely surrounding the mesh, and of a thickness varying from two to four inches. It might be suggested that this construction is not strong; but when we remember that railroad bridges of long spans are now being constructed on the same principle, that roofs for warehouses, factories and other important structures are being constructed according to the Monier system, we may rest quietly on this score. The first use to which the Monier system of construction was put was in building sewers. Its great strength immediately suggested the construction of bridges, roofs and other work of that character.

Monier culverts for country roads are now being made according to the above plan. That is, a wire frame work is formed spanning the stream or ditch below it; one inch from the under side of the wire is placed a form made of inch boards. The wire is blocked so that it can not approach the form or board center under it by an inch. On top of this is placed the cement concrete, in a way to surround the wire and come some few inches above it. The abutments and foundations of the culvert are made of the same material, and the hole is filled with road-making material to the proper level, to conform to the general contour of the road itself.

The first use of this Monier principle in architectual work was for glass factories. Monier, the inventor of this system, was a Frenchman. His patents were taken out some years ago and have now about expired.

* * *

In many of the cities of Europe the sewers occupy a very distinct relation to street cleaning. It is the custom in Paris to brush all of the refuse on the street into the gutters, turn on the water and drive it into the sewers. This is a part of the street cleaning operation. One will notice in time of snow that the street sweepers come out in force and sweep all the snow possible into the gutters, turn on the water and wash it into the sewers. As soon as the sun appears and there is a little thaw the ice and all of the refuse matter, which is a part of it, is immediately treated in the same way. In the matter of cleaning the streets one need not imagine that any very large volume of material is washed into the sewers. It is an every day operation. On the street in which the writer lived during eleven months of his stay in Paris three street sweepers could be seen every morning between eight and half-past eight, marching in line up one side of the street and down the other. This cleaned a wide street. After they had passed over it the water was turned on from the water works, which were designed particularly for street cleaning. For a few minutes only it would show unclean in the gutters; after this the stream of water would be as clear as a mountain stream. The water used for this purpose in Paris, it may be known, is pumped directly from the Seine. The drinking water is a separate and distinct system. It comes from lakes thirty or forty miles distant. However, it is no uncommon sight in Paris, after the water has been running a few minutes in the gutters, to see housekeepers take their buckets, go to the outside, and with dippers fill them with water. In truth, no one feels any great anxiety about its cleanliness. When one can see the yellow sand washing over the stones in the gutter and notice its perfect cleanliness he feels fully assured as to its character. When streets are cleaned every day or every two or three days there is really very little impure material to be washed away. If one leaves a street for a year or two years without cleaning, or if a community does the same thing, the flushing of the gutters from the water works is altogether a very serious operation. The adjustment of the grades on the Paris streets is so nice that when those who have charge of the flushing of the gutters desire to change the direction of the flow of the water they merely throw down a piece of jute, which forms a dam. On the relatively level streets this changes the direction of the flow. This indicates not only nice street cleaning, but at the same time fine engineering. A piece of jute sacking may not form a dam more than two inches high, yet it is sufficient to change the direction of the current from a gutter flushing hydrant, and thus aid the street cleaning.

* * *

In many sections of the United States the question of the disposal of sewage is quite different from what one finds it either in Great Britain or England. While there are more days of rain in either of these countries than with us, on the other hand we have very heavy rains, which are not known to the sections named. Even through the northern parts of the United States rain-falls of a semi-tropical character are not uncommon. Therefore, a plant having to do with the disposal of sewage, either on the irrigating, filtering or precipitation plan would be found unsatisfactory. A rainy season in France is practically without heavy rains. It may rain every day for weeks and months, yet the rain is never heavy and no one is ever seriously inconvenienced by it. In the United States we may have several days of dry weather followed by one or two days of heavy rain-fall which, under ordinary arrangements having to do with the disposal of sewage, brings about a very embarrassing condition. A plant arranged either for sewer irrigation, filtration or precipitation in England, Germany or France, would oftentimes be found utterly inadequate for an American city of smaller population and area. It would appear from the above statement that a plan having to do with the disposal of the sewage of cities in America would be more successful were the house drainage separated from the general street drainage.

The house drainage would be measurably uniform; while, of course, the street and rain-fall drainage would be influenced altogether by climatic conditions. Our country is too new and the evils of the pollution of streams are, at this time, not sufficiently pronounced, or, to be exact, not sufficiently to bring about a serious consideration of this problem. If one considers the question closely he will find, however, that few or none of the large cities of America are provided with pure drinking water, and that its impurity is largely owing to the discharge of sewage material into the source of drinking water supply. While this question is not altogether a live one at this time, it is sure so to be within a few months all over this country. Those who are practically interested in water supply realize this state of affairs and when they are addressed by those not liable to give them trouble, they uniformly acknowledge the true condition of things, which is that few or none of the water companies of the large cities and towns are fully satisfied with the character of their water supply. This is true, owing to the discharge of sewage material into the sources of drinking water supply.

Louis H. Gibson.

LOUIS H. GIBSON.
See biographical sketch in January number, 1893, page 15.

ROAD ENGINEERING EXTRAORDINARY.

THE most unique road engineering project in which the writer was ever engaged was while in Europe, surveying off the North British coasts. An engineer proposed throwing a road across the narrowest part of the channel separating Britain from Ireland, which, between Cantire in Scotland and Tor point on the Hibernian coast, is little over a dozen miles. The specification was for a national highway of the uniform width of 100 yards, to have two roads, a double railway track, and two foot paths for passengers. Like all big undertakings, this project has now been in abeyance for years. Every now and then it crops up, and will, I suppose, one day be constructed. For the edification of engineers in other countries who may ever have this kind of work in view, some notes on the scheme will be useful. I will reproduce a few of the inventive engineer's remarks contained in a brochure, and leave an opinion to be formed by the reader:

The water which divides Great Britain from Ireland is all that exists to maintain the actuality of a divided nation.

Link the two islands by an isthmus, and one realm becomes a fact. Only 14½ miles of water divide the two countries at Cantire, a distance so insignificant in the estimation of engineers that a bar could be erected easily and expeditiously to join the islands forever, the bar serving for free transit from shore to shore, and excluding the inflow of the mighty gulf stream which now floods the Irish sea, loughs, and shores of the eastern coasts of Ireland and western shores of Scotland, England and Wales.

The ship-way for the vessels from the north Atlantic to the Irish sea could be by two canals of short lengths at Cambeltown and Tarbert, through the peninsula of Cantire, in addition to the existing one at Crinan into the Clyde. The effect of diverting the gulf stream from the Irish sea would, it is estimated, cause the subsidence of the Irish sea, so as to lay bare 1,000,000 acres of land now covered by shallow water on the shores and loughs, and favor naturally land drainage near the coasts.

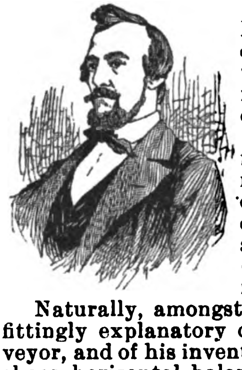
By contrast with a similar undertaking, the reclamation of the Zuyder Zee by a dyke twenty-five miles long (now in progress in Holland), it has many advantages. In my proposal for joining

Great Britain and Ireland, the distance is ten and a-half miles less than the Holland dyke now in progress, and the stone and earth for the isthmus are close on the spot, ready for gravitation from the Mounts of Genmakeram (1,300 feet high), Carnlea (1,200 feet), Clady (1,000 feet), Escort (980 feet), also from Dees Point at Cantire. In Holland the materials have to be brought from a distance.

The whole subject has been stated succinctly in two editions of a pamphlet on and entitled "The Land Junction of Great Britain and Ireland," published about 1880–82 (by Templeman brothers, 36 Great Portland street, London), with charts of the proposed bar to form a high causeway from land to land, and of the currents of the inflow of the gulf stream, marked shaving six knots an hour. The greatest depth is 400 feet. The sub-stratum of the sea bottom is of shells, stone and rock—an admirable base for a superstructure which the genius of the present age might create to mark an epoch of modern science, conjoined to patriotism.

For six months the present writer was engaged in observations of all the bearings of this notable scheme, and it is deemed worthy of the equal consideration of those who have the welfare of England in mind. As a national work carried out at public cost, so as to insure a free way for the united island, I estimate the cost at between two and three millions of pounds, if convict labor were used, and the time required to effect the junction and cut two short canals, about two or three years.

J. C. King.



Mr. John Charles King is an Englishman, London born, country bred, with a wide range of experience in his profession—a surveyor and engineer—acquired by travel and important managerial positions, in which road-making, drainage and forestry were leading features.

His love of hard work in land improvement, building, farming, etc., seems to have left him ample leisure in the midst of his work for literary pursuits—for contributions of various scientific papers for English, French and American journals, and for the lighter effusions of fancy in verse and lyric pieces. "A Hundred Songs From the Saddle" (some written on horseback during the waits at cover-side, mainly), attest his versatile genius.

Naturally, amongst his writing, road-making, highway law and drainage are fittingly explanatory of his experience of fourteen years on the highways as surveyor, and of his inventions of a simple road-bonding tram-rail, non-slipping horseshoes, horizontal balance of body of two-wheeled vehicles on steep hills, three-wheeled omnibus (trail-wheel behind), cylindrical carts for road or rail, for dust, or refuse, and numberless minor inventions in agricultural implements and machinery. In cultivation of crops his system of interlining doubles the yield. Of course, his prime aim is the unification of the British kingdom by his large idea—which he, however, thinks but a small enterprise practically, as it is a work of gravitation and cementation of materials. It has won encomiums for its originality and comprehensiveness from all the statesmen of England for the past fifteen years. But politics are a sensitive trade-cult, and "The Tom Fiddler's Ground" that his isthmus would obliterate, would spoil the "greedy gain" now made by both parties that play the game of politics in England.

He is the projector of *The Road*, a riding and driving journal, issued from time to time by the firm of King & Co., 50 Booksellers' Row, London, of which he is now the head.

ORIGINAL RESPONSIBILITY OF CITY CIVIL ENGINEERS.

THROUGH the agitation of the press the community at large are becoming awakened to the demands for the physical improvement of our cities, towns, and villages.

An investigation of these demands reveals the fact that a great portion of them arise from a want of a sufficient or proper plan of original improvement, which now necessitates a reconstruction at a considerable if not not complete loss of the original improvement.

Such things justly provoke the tax-payer who is now called upon to bear the burden and bear the consequences of errors that should have been avoided. Frequently, these errors have been made from want of advice and direction by a competent engineer. More often they have been made because of the "penny-wise and pound foolish" policy so largely pervading smaller city and town governments.

Many engineers, who have had their plans subject to such a policy, are to-day endeavoring to escape the criticism, now shifted upon them by these economists, by saying, "I told you so," but their excuse is not readily accepted and probably they deserve part of the "roasting" they are getting.

Professor McNally, the Chicago phrenologist, says an engineer requires a large development of the perceptives so as to see the future requirements of an undertaking, and also well developed tact to continue and have adopted plans tending to that end. Herein common sense and the science agree.

No engineer should engage upon an undertaking without giving it a thorough investigation with all its surroundings. No matter how small the undertaking there will be local and modifying influences to be considered and dealt with. At this point the engineer may employ his perceptive faculties in apprehending what future requirements may possibly be, although present indications may not point to them as even probabilities.

While he must of necessity be a practical man, ever ready to meet and deal with emergencies, he must have a broad enough mind to live like a Blaine, a generation ahead of his associates.

It is the duty of every professional man to keep a pace ahead of his fellow-man in knowledge and thought of matters pertaining to his chosen profession, and we have a right to expect of him that he shall see the end from the beginning and be in a sense an educator of public opinion in his line, especially in impressing upon those by whom he is employed the necessity of following his directions. For instance, an engineer who is associated with a district to be improved for residence, should observe what the natural features and conditions thereof are and study how to further aid nature in supplying details that will conform to the general plan usually so wisely laid before us. He should be willing, by conversation and contributions to the local press, to call attention to the necessity of starting in on developments in a proper manner. He can roughly diagram how drainage basins should be associated, streets laid out, parks and public grounds reserved, etc.

Too many engineers act as though they think their skill is only to be employed in battling down and destroying what nature has placed, as though they were obstacles in his way.

People of artistic taste in home surroundings welcome the surveyor possessing enough art and originality to break away from the old stereotyped form of rectangular platting and provide them with something true to nature and breaking the monotony of sameness. Some general form must be observed to provide convenience and conform to leading thoroughfares, as the special cases may require. While the opportunity is thus at hand to follow and develop what nature has provided, a proper system of sewerage and drainage can be easily inauguarated. These are matters almost invariably deferred until after street construction, when they properly should precede them.

In the January number of PAVING AND MUNICIPAL ENGINEER-

ING, Mr. J. W. See, of Hamilton, O., makes the assertion that sewers "have nothing whatever to do with the question of streets." I should like to change his expression by saying streets should have nothing to do with sewers. So far as my observation and study has led me I favor the removal of sewers from streets to alleys, which should be more commodious than they are usually platted. But to say that sewers should have no part with street drainage is rather a broad assertion which will bear much study and should be determined for each special town or district. Whatever the disposal of street drainage may be, the first grade made should be such as will meet all future requirements. Let no false economy be practiced upon the grade.

Mr. See, in the article before referred to, makes an excellent point on the importance of bringing a street to a proper gradient by cutting rather than by filling. It is seldom advisable to make a fill of any great length in front of property that is not too low for drainage.

The portion of grass plot or tree space and of planting should early be arranged for. Trees are usually planted too close to the sidewalks, and in later years their roots, which so eagerly seek the sand bedding of the pavement, will be sure to break and derange the best stone, concrete or brick pavement.

Having collected all required data, a course of study and investigation of the best practice upon the proposed improvement should be made. The investigation should not stop with the reading of one man's ideas, the report of one method employed in a similar case, or the visiting of the nearest work of the same class, but the collection of facts and data from good authority holding different views and employing different practice. These will aid you in your deliberations to decide upon a method to pursue.

There are engineers ever ready to furnish officials " standard " printed plans and specifications so finely prepared as to fit all cases —like a patent medicine—and about as reliable.

It is in the display of an understanding how to manage the varying conditions of the case that makes an engineer valuable and appreciated. He should be original but not an experimenter or given to the introduction of new schemes for their novelty. Having matured the plans another obstacle is frequently met in having them sanctioned by a higher authority. It is surprising to notice how many men think they possess a correct idea of how any piece of public work should be executed.

Another evil sometimes encountered is one of the legal profession, who imagines he must prepare the specifications in connection with the contract. Possibly he has an old class-mate, now a practicing engineer in another state, who sent him specifications which he had prepared for similar work there. If such be the case, he should be admitted with the patent medicine man.

These are grievances rather than responsibilities too well known to the engineer to bear enlarging on here. Any objections raised should be patiently heard, considered and accepted for what they are worth. Valuable suggestions and thoughts often come from a very unexpected source.

Engineers, as a class, are rather sensitive regarding their pet theories, and have a dread of admitting an error of judgment or practice; but they should be willing to receive advice and make modifications if good attend it. In case of doubt or disagreement, consult a brother member of the profession.

This point, in conclusion, I would like to impress: Do not lower your professional or personal dignity by permitting your plans and operations to be altered or modified so as to divert the intention for which they were projected, or bring discredit upon your work. Do not let the man who is so narrow-minded or selfish as to be willing to "let the future take care of itself" influence you. Neither be discouraged because the majority may not be in your favor, for more than once the whole world has been wrong and one man right. Do not be stubborn, but be firm. Better sacrifice the few dollars you expected to earn and respectfully decline a position where you can not exercise your judgment, than for the policy of pleasing a few lay yourself and your ennobling profession subject to everlasting censure of those who will follow and suffer.

Frank Knight.

AN INSTANCE OF VILLAGE IMPROVEMENT.

In the spring of 1881, J. H. Bromwell, Mayor of Wyoming, Ohio, in his annual message, called the attention of the village council to the good work that had been done by the Village Improvement Society and urged the necessity of having a general survey made of the village, that an intelligent system of grades might be established and public improvements made upon a uniform system. The recommendations of the mayor were adopted by council and I was engaged to make a topographical survey of the village in order that sufficient data might be obtained for carrying out further improvement. Upon the completion of this preliminary work, the village council immediately commenced the actual work of improvement, which has been carried forward from the spring of 1882 to the present time on the plans recommended. The total length of streets in the village in 1882 was 61,334 lineal feet; in 1892, 70,334 lineal feet. Since 1882, 50,032 lineal feet of streets have been improved at a cost of $22,500. Prior to 1888 Wyoming had but little to boast of in the way of sidewalks, but in that year she became one of the pioneers in the new sidewalk crusade, and the following statement shows what has been done in this very important part of public work since then:

CEMENT SIDEWALKS LAID IN WYOMING.

1888	5,985	lineal feet	$5,936 02
1889	3,450	"	1,336 47
1890	2,274	"	1,546 50
1891	415	"	321 62
1892	49,133	"	41,844 88
	61,257	"	$50,985 49

The total length of single walks laid in cement being eleven and three-fifth miles.

In 1888 the question of issuing bonds to the amount of $15,000 for sewerage was favorably voted upon and a commission was appointed to submit a general plan for the sewerage of the village. Under the direction of this plan and the sewerage committee of council there has been expended for sewerage purposes the sum of $12,350.

The total amount expended for public improvements during this period has therefore been as follows:

For street improvements	$22,500 00
For sidewalks	50,985 49
For sewerage	12,350 00
Total	$85,835 49
Add amount paid for school buildings including new High School property	35,000 00
Total	$120,835 49

The above amount while representing the amount actually paid by the village government does not, however, represent all that has been expended for public improvements and there should be added $25,000 each for amusement hall and electric light plant, making a total of $170.835.49.

As the last item of public improvements we would call attention to the new water-works, just finished at a cost of $35,000. The plant consists of a fine pumping station, containing first-class boilers, three deep well pumps, and one large force pump; also there are six and one-half miles of pipe and a reservoir with a capacity of 3,000,000 gallons.

There are two boilers set in one battery but bricked so that they can be run either together or separately. They have a combined capacity of 150 horse-power. They are made of the finest grade of flanged steel, three-eighths of an inch thick, and are capable of carrying a working pressure of 150 pounds.

The source of water supply is derived from driven wells each eight inches in diameter. One of them is 159 feet deep, one 146 feet, another 140 feet and another 130 feet. At present, however, only three of these wells are being used.

The reservoirs being 3,000,000 gallons capacity and situated 230 feet vertical height above the pump-house, give a pressure of very nearly 100 pounds to the square inch. The 10-inch pipe leading down from the reservoir, distributing the water through the village is about one mile long and will deliver at the lower end 2,188 gallons of water per minute and will supply eight 1⅛-inch smooth nozzle fire streams, and with 100 feet of rubber-lined 2½-inch hose, each nozzle will throw a fire stream to a vertical height of 146 feet, or a horizontal distance of 186 feet.

As to whether these improvements have paid for themselves or not, we find a conclusive answer in the affirmative by comparing the valuation of property in 1882 with that in 1892. In 1882 the tax valuation was $500,000. In 1892 the tax valuation was $1,200,000. *E. F. Layman.*

E. F. Layman was born in Cincinnati in 1835, educated in the public schools, studied mechanical engineering in the office of Frank Millward, and civil engineering in the office of R. L. Read. He was head draughtsman at a number of the large factories before beginning the practice of civil engineering. He was assistant engineer on the Indianapolis Belt railway in 1873 and was in charge of surveys for the Cincinnati depot grounds on the Cincinnati Southern railway in 1875 and 1876. Since then he has been engineer of the village of Wyoming, Ohio, since 1881, and has had charge of the construction of its water-works and other public improvements. He is also engineer for five other villages in Hamilton county, besides having a large private pratice.

MAINTENANCE OF ROADS IN FRANCE.

III.

From the method of maintaining a macadamized road, as I have described it in my last two articles, one might conclude that the filling of the depressions in the road can not equal the amount of stuff taken away, and consequently the thickness of the macadam must continually decrease; this is very true; in fact, if it was found convenient or necessary to lower the elevation at some given places, it would be quite possible to so direct the cleaning as to let the wagons wear off the whole surface uniformly or nearly so, but, on the other hand, if the engineer thinks the macadam is getting too thin, it is an easy matter to raise the surface.

From experience, we know that soon after the operation of spreading new material, as indicated in my last article, there appear new depressions that will ordinarily disappear under the action of cleaning and traffic; then, if we want to raise the surface, we may repeat our process of spreading stone by patches exactly as we did at first, and repeat the operation as long as the weather permits, or as long as it is needed.

It will be seen by that, that the "cantonnier" can use about as much or as little new stone as he pleases, or as the engineer orders him to use, and yet keep his section in good shape.

On a well regulated road there must be an amount of new material spread yearly on its surface equal in weight to the amount of stuff, mud or dust, that has been raked or swept off; but that material need not to be exclusively clean stone, because a solid roadbed contains, besides stone, a certain amount of pulverized stuff that fills the interstices; the fact is, that if a portion of a road has lost, say 100 cubic yards of stuff, 60 cubic yards of clean stone would about replenish it, and as a consequence there would be no harm if some dried mud was mixed with the new stone in refilling. It would sooner get packed together and it would not be so rough on the wagons. It is easy to see, then, that a judicious use of mud might be quite an item in maintaining a road-bed, both in economy and convenience to travel.

From what I have said it will be seen that maintenance of roads consists of two operations—removing the mud and dust, and spreading of new material. The first operation requires constant attention, while the second requires constant attention, good judgment and some experience.

This method of refilling by patches can not be exclusively employed. In cities, for instance, the surface is allowed to wear down uniformly, and, when needed, general refillings are made, covering the whole road, which is then sprinkled and rolled as soon as possible. But here I am speaking especially of roads through the country where the patching method is mostly used.

It will be seen that such method requires, as a whole, constant attention, and the best way to get that is to divide the road into sections to be under the charge of one man. The length of such a section ought to be such that the "cantonnier" is kept busy the whole year round, yet able to keep it in good order. He gets used to his section and knows the bad places where particular care is needed. The length of those sections can not be given here even approximately. It depends on the amount of traffic, on the succession of seasons, on the quality of stone, etc. In France, where travel may be estimated at probably five to ten times what it would be here, sections are from one-half of a mile to one mile.

Experience has proven that roads wear off in summer just as much as in winter. Of course this does not apply to northern climates where snow covers and protects them for months every year; yet as the proper time for spreading new stone is in the spring of the year, it is often found advisable to give the "cantonnier" some extra help to enable him to get through with that most important part of his work in proper time. For instance, in some countries or in some years the winter will hold on until the spring is too short and but few repairs can be done. Then it will be necessary to rush for a while and stop during the summer season, to start again in the autumn, if the weather permits.

There will be plenty of work for the "cantonnier" during the summer. He has to repair the ditches, to keep the road-bed in shape, to attend to the trees, and get the material ready for the next season. I will speak of those extra works afterwards, and while we are speaking of maintaining the macadam, and before we get through with it, I will add that in spite of all the vigilance of the engineer, through some extraordinary rainy season, or through the carelessness of some "cantonnier," some parts of a road may get so badly out of repair that they will need extra precaution and extra work to reclaim them before they are totally ruined.

ARTHUR LAGRON, C. E.
See biographical sketch in January number, 1893, page 17.

Next month I propose to tell how repairs are made. *Arthur Lagron.*

PAVING BRICK; THEIR MANUFACTURE AND USE.

[At the recent meeting of the National Brick Manufacturers' Association, in Louisville, Ky., the following paper on "Paving Brick; Their Manufacture and Use," was read by Mr. W. S. Williams, of Canton, Ohio:]

The clay should contain the proper amount of silica, aluminum and iron, with the necessary amount of alkalies to thoroughly flux it. The silica, aluminum and iron are practically non-volatile, and will receive a high degree of heat without injury.

The clay must be tempered or pugged not with so much water as to produce a hydraulic resistance in compressing it, but with just a little water, just enough to induce a molecular change in the clay; it should be compressed to its utmost density, so as to assist nature as much as possible in forming a compact mass. In drying, the clay will creep together and shrink until the particles touch each other and then stop.

The rest of the water must be taken off at a red heat, when more shrinking takes place. The brick at this stage is ready to become a semi-molten mass, and if properly treated, when done, the product should be a dense homogeneous mass, from center to exterior.

Vitrified, so to speak, throughout, not in structure or series of structures, but a dense, compact mass, they should be so treated as not to become crystalline, or of a vitreous nature, but tough or annealed as it were, so as to have the greatest cohesive strength possible. This gives us a material with greater strength than any now known. In a crushing test, as shown by our testing laboratories, the vitrified brick proves to be about one-third stronger than granite.

Trautwine, who is regarded as authority by all civil engineers, assumes the weight of ordinary brick work as 112 pounds per cubic foot, and that it would crush under thirty tons per square foot; then a vertical column of it, 600 feet in height, would crush at its base under its own weight, and average granites that weigh 165 pounds per cubic foot would sustain a vertical column of 8,145 feet before crushing at its own base. Hence, as vitrified brick stand over one-third more under a crushing strain than granite, the brick vertical column will be over ten thousand feet in height before crushing at its base, under its own weight. Trautwine gives the average crushing strength of granite at six hundred tons per square foot, and from the best information we can get, our testing laboratories give the average crushing strength of good vitrified brick as over nine hundred tons per square foot.

Vitrified brick are comparatively new to our architects, and their value is as yet almost unknown to them, but in the near future this brick must, of necessity, take a very important place with them, when they once thoroughly understand that they take no dampness and are stronger and more durable than granite.

In our larger cities where the air is tunneled with fifteen and twenty-story buildings, the width and strength of walls is a very important matter. Space can be economized in thickness of the walls by reason of great strength of the brick. In case it is necessary, they may be buttressed either exterior or interior, or both, and thus more room secured in the structure.

In a vitrified brick building, there should be a brick used in the interior of the building made of the proper proportions of clay and sawdust or its equivalent. This brick should be burned until it is thoroughly vitrified, the sawdust being consumed in burning, the brick left honey-combed, or full of air cells as it were. This brick should be carried up with the masonry as an inside lining of the walls in the interior of the structure; no furring, no lath required, plastering can be applied directly on the walls. The cellar should be paved with vitrified brick, and no brick allowed in the entire structure that is not vitrified.

This would give us a structure, the walls of which would have great strength, fire-proof, practically a non-conductor of heat and cold by reason of the air cells in the inside course of brick, walls perfectly dry, as they would not absorb a particle of moisture from turret to the bottom of the foundation, a fact which can not be said of any other known building material; and with this end in view it is absolutely requisite that we make the very best vitrified brick; that quality and not quantity should be the end to accomplish. The people of this country are now investing their money in permanent improvements, and they demand the very best material that can be produced.

The paving of streets, and roadways, has for a long time been a source of much anxiety to the engineer. Granite, expensive, noisy and eventually slippery and becomes as rough as coble-stone pavement. Asphaltum, costly, slippery and does not wear well. Macadam grinds up and forms a paste when wet, and is carried off by the wheel in the shape of mud, when dry it blows away, and is lasting and wears well only when there are one or two feet of snow upon it. Wood is not lasting and is a great absorbent, consequently unhealthy.

Vitrified brick, however, has taken a great load from the engineer's mind. It is durable, comparatively noiseless, inexpensive and easily repaired.

In the vitrified brick, treated as heretofore spoken of, we have the combined silica, aluminum, and iron; the resultant product gives us a material that is harder than steel and of cohesive strength, a material that will not be affected by the iron or steel tires of wagons.

No, the calks and toes of the horseshoe, the twelve chisels on the shoes of each horse, are undoubtedly the greatest enemy paved streets have to contend with. The ingenius blacksmith may change from iron shoes to steel and keep these chisels in excellent repair, yet this steel must give way to the vitrified brick. This is the first paving material yet found that would resist the horse's shoe. When the brick are manufactured as heretofore described, there is no way of calculating the life of a brick pavement, as there seems to be nothing that can wear it. The brick are hard, and yet do not become slippery, the draft horse always securing a good foothold.

In vitrified brick, the civil engineer will find just what he has been looking for, in permanent structures, such as arches, tunnels, sub-structures of all kinds, conduits, and especially in sewers. If he is constructing a sewer where there is much grade, he will find a material that will withstand the rasping and filing of all the sand and gravel that will pass though; it being vitrified it is non-absorbent. Acids and noxious gases, will not affect them, and find no place there. In a sanitary point of view, this fact the engineer dares not overlook.

Vitrified brick have come to stay, and have been staying on the face of the earth for a long time. By the rivers of Babylon and Ninevah we find that there have been unearthed glazed brick, and brick enameled. In the great brick city of Babylon, Babylon the city of brick, occupying in extent five times more than the present site of London, environed by a wall of brick, three hundred feet in height and eighty-five feet in width, we find that the hanging gardens were sustained by brick arches, brick laid in bitumen the equivalent of our combined coal, tar and ashphalt, the bed of the river paved with brick, and in their temples brick, vitrified to azure hue, after being placed in position in the structure. Stamped in the brick, their first system of writing is given us, viz., the cuneiform. On what were once the banks of the Euphrates and Tigris rivers we find handed down to us the history of thousands of years ago. It tells us of the deluge, when the face of the earth was covered with waters. It informs us of the first great kingdom after the subsidence of the waters. We have stamped upon brick the name of one of their first great rulers, viz., Nimrod, the mighty hunter before the Lord. This history was not handed down to us written upon the columns of stone, nor monuments of brass. Such material seems to have succumbed to the action of the ages. But it is given to us on clay tablets. Simply brick, and nothing more.

[In the general discussion on the paper, remarks were made as follows:]

Mr. Adams: Mr. Williams has given us a very comprehensive paper. It is a revelation to many of us. We have been advised of the fact that brick when well made and properly dried and burned and laid, is the coming pavement for this country. And I want to impress this fact upon this convention. Nothing can stop the progress of brick for durable, lasting street pavements but the brickmakers themselves, by making an inferior article. It is with the brickmaker and upon him alone that depends the future of this great industry. In our city we have several miles of brick pavements, and we have one street, I am glad to say, it has only one square laid with brick, that the pavement is wearing out after one season of ordinary travel. We do the brick paving industry a great injury when we turn out anything but a good brick.

Joseph Stafford, Springfield, Ill.: I have left the past behind me and from now on am going to live in the future. In my judgment it is not a question of paving brick for street pavements, but how to get the proper clays and how to make them tough. I am here to say that I believe the clays that are right among the shales is the best for making paving brick. This may seem a little strange, but I believe in telling the truth as it appears to me. It is not a question of selling brick for street pavement, but a question of how to make them.

W. A. Rieman, Vincennes, Ind.: I can heartily agree with what Brother Adams said about the quality of paving brick made throughout the country. I know from personal observation that many who are claiming to make paving brick are not doing anything of the kind. I visited a yard sometime ago where they are turning out a large number of these so-called paving brick; they are made in a very inferior manner and do not answer at all the description of a paving brick. I asked the manufacturer why he turned out that class of brick, and he said: "Oh, they are all right; they look all right, and we can sell them." Gentlemen, a brick of that kind has a tendency to discourage the use of paving brick, and it is illustrated in the city of our honorable president as well as in several other cities.

Mr. Rieman read extracts from a report of a special committee of the board of public improvements, of St. Louis, who visited Philadelphia, Washington, D. C., Wheeling, W. Va., Chicago, Cincinnati, Columbus and Newark, for the purpose of examining the brick pavements. The committee concluded that it was not advisable at present to recommend the use of brick as a paving material for streets.

D. V. Purington: I want to say that brick paving has probably never received a more severe blow than from the article just read, and which was printed in the papers throughout the country. I have no doubt but that the report of the committee was, to a great extent, true, and while I do not want to get up a discussion as to the clays in the different parts of the country, I want to say that in every town mentioned in that report the paving brick were made of clay largely of a fire-clay nature and not of shale. If the committee from St. Louis had desired to make a fair report as to the paving brick throughout the country, they should have visited some of the cities where shale clay brick were used, and not selected all where fire-clay brick were used. Mr. Adams struck the key-note of the situation. We should be more careful in the selections in the matter of paving brick than of building brick. If a brick is a little off color, in laying up a wall, you can lay it in the center and it will not appear in the face of the wall, and it will not hurt the wall, or the man who puts up the building, or the one who makes the brick. But in paving a street, every single individual brick is exposed, and a half-dozen soft brick will ruin the reputation of the brick-maker and the man who lays the street, and I want to impress it upon the minds of the men who make paving brick, that there is no part of their work so important as the sorting of their brick.

In the first place, Washington has not a single street paved its entire length with brick of any kind or character. I myself visited Washington to investigate the conditions, and I found that the board of commerce had ordered a brick pavement laid in front of their building. And the man who laid the street laid brick for a length of about 150 to 250 feet on one side of the street, and on the opposite side of the street they had laid 150 feet with asphalt and 100 feet with granite blocks and the other 50 feet with wooden blocks; that proves that part of the report in regard to Washington false. In regard to Columbus, the statement in regard to the number of miles is absolutely false. It looks as though these reports had been prepared in the interest of the asphalt companies. Now Mr. Adams has given you a sermon in a few words, you gentlemen who are manufacturing paving brick, and all who are contemplating the manufacture of paving brick. You must have thoroughly prepared product and a thoroughly burned product; and, gentlemen, you must not put anything else on the market. I say if you follow that rule it will not be a question as to what kind of paving to use, but it will be a question of getting the brick.

Mr. Eudaly: I want to say a word about Columbus. We have a State Association in Ohio, and at one of our conventions a gentleman came in, and, when the subject of brick pavements was being discussed, told us that there was a street in Columbus where they had paved part of the street, several blocks, I think, with brick, and the other half with stone, and had allowed the pavements to lie for a certain length of time, and had finally taken up the stone and laid down brick. This happened in the very city of Columbus named in the report. As has been said before, the brick pavement is the pavement of the future, and there is no question about it. It is simply a question of making good brick. Let us look at it from a business stand-point. The man who has the best paving brick, the best building brick, or the best of any kind of clay ware, is the man who is going to sell it, so long as he is in the business. There is no question but that brick is better than asphalt and stone, and the people are finding it out, and brick are going down in the streets and roadways of this country, and there is no help for it. Every pavement that is put down makes it more sure, and the manufacturer who starts early to make brick that are good is the man who is going to make the money.

D. P. Guise: I read an article in the *Public Ledger*, of Philadelphia, very favorable to brick pavements, and about the same time there was an article published in the *Times* condemning brick pavements, and I said to myself, there is a "nigger in the woodpile" somewhere. Brick manufacturers are aware that the asphalt companies are doing all in their power to oppose the brick pavements. Last year, I do not remember just what time, a gentleman came to me and said, if you will make your paving brick three inches thick, five inches wide and twelve inches in length I will take your entire product. He said we want to meet a competition on the part of the asphalt companies, and gave as an argument that large size brick were more salable, consequently he wanted a large size brick. I spoke of this thing to show what opposition we are working against.

E. R. Harper, Akron, O.: About ten years ago the question of street paving came up in the city of Akron. For two or three years it was a fight between the asphalt people and the stone people and the brick people, but we finally succeeded in getting brick pavements down on the streets, and I am proud to say that since then we have no pavement of any other description, and you will never see anything but brick laid in the streets of Akron. In the matter of brick pavements the manufacturers must always keep quality in mind. One mistake paving brick manufacturers make and have been making is, they say to property owners and members of council and parties about to bid for a pavement, "I can furnish it to you so much cheaper than any other pavement," and then you are compelled to put your brick upon no foundation at all, comparatively. You go to the council and say, "I am going to put the brick in on a sand foundation," and you put your brick upon a sand foundation and enter into competition with an asphalt company that has put their pavement down on a hard rock foundation, and I say you are making a mistake. No board of improvement should be led to believe that it is going to cost much less to put down a brick pavement than any other pavement. Nine years ago after the discussion that had followed my urging the use of brick pavements, a committee was appointed, and they made a tour of cities that had brick pavements—Wheeling, Bellaire and several other cities—and they came back with a report that settled the brick question in Akron for that time, because those people had laid the brick down on a sand foundation, and the result was the committee found there worn out pavements; the brick were not injured, but they did not stop to consider that, they simply said the brick are not good. You ought to educate your engineer that brick ought to have a good foundation upon which they can rest and rest all the time. So far as the brick are concerned, they are all right, but you must have a good solid foundation. [Applause.]

Frank B. McAvoy: I want to say a few words in regard to street pavements in Philadelphia. We have thirty-five miles of streets paved with brick, and with few exceptions where the brick put down were put down right the streets are in first-class condition, and the majority of the members of the city council are of the opinion that it is a good pavement, and would like to see more put down. The teamsters like it, they say it is easier on the horses, and prefer it to any other pavement. So far as our council is concerned, you can have anything you want in our city if you are willing to pay for it. Last year there was put down in Philadelphia 10,000,000 brick, and, in the future, brick will be laid in Philadelphia. We are slow in some things, but we are doing the fair thing in the way of pavements of brick.

Mr. Adams: I would like to say to my friend from Akron, that the brick street to which I referred in the city of Indianapolis, and which is now practically worthless, was laid on a concrete stone foundation of the very best character.

On motion of Mr. C. S. Ettla, of Clearfield, Penn., it was decided that the standard size of brick for paving purposes be the same as a standard size for building brick, that is, 8¼x4x3¼.

THE SEWERAGE OF MEDINA, NEW YORK.

The village of Medina, New York, is the location of the celebrated sandstone quarries. The corporation is about two miles square, and contains five thousand people. It is divided into four parts by the Erie canal, extending east and west, and by the Oak Orchard creek, which runs from south to north. The surface slopes to the north and toward the creek. The creek, north of the canal, runs in a deep gorge. The rock lies quite near the surface, and renders it necessary to exercise great care in designing sewers so as to have them deep enough to answer the purpose, and not to entail unnecessary expense by going too deep in rock cutting. There were in the village two or three stone drains, with rubble walls, laid dry, and covered with flagging. These, in course of time, were made to do duty as sewers, instead of being restricted to their legitimate use as drains, and with the usual results. A large part of the village had no drainage at all, except on to the surface of the ground.

For a long time efforts have been made to get sewers built for the relief of some particular locality, but without success. In 1889 the legislature passed an act authorizing incorporated villages to appoint boards of sewer commissioners. There are five of these commissioners, and they serve for five years without pay. They are not to be all of the same political party; one goes out each year. By a little management the board of trustees of the village of Medina was induced to appoint sewer commissioners under the act of 1889. The sewer commission is authorized to expend not to exceed one thousand dollars for sewer plans for the village. These plans must be submitted to the state board of health for their approval before they become effective. The state board of health sends an expert sanitary engineer to look the ground over with the plans in hand. Their action is based on his report.

If the taxpayers so decide, the whole system may be put in at once and the village bonded. Otherwise, on a proper petition of the property owners on any street, the sewer commission has power to lay a sewer in that street, if they deem it proper. By an amendment of the sewer act the streets which have a continuous line of sewers are to be taken for sewer purposes as one street. This enables people at the upper end of a line of sewers to get an outlet when those at the lower end are all opposed to it.

Under this law the sewer commission of Medina employed the writer to make plans for the sewerage of Medina. These plans were duly approved by the state board of health, and in April, 1891, the first sewer was constructed on West street. It is about a half mile long. Other petitions have since been presented, and two and one-third miles additional of sewers have been built. I will now describe the method of preparing the plans:

Center street runs through the village from east to west, entirely across the corporation. West street runs from the corporation line on the south to the canal on the north. By running a transit line through these two streets they could be platted, and nearly all the other streets platted from them by measurement, without the taking of angles. The levels were run through the centers of the streets and alleys, care being taken to note accurately the street intersections. The party consists of a leveler, two tapemen using a steel tape, and a rodman. The hind tapeman notes the street intersections. Buildings with low foundations or extra deep cellars are made note of. Angles in streets between intersections are measured.

After the map is made, the contour lines are drawn, the location of the main outlet is decided upon, and the study of the location and grades and sizes of the sewers begins, the nearness of the rock being kept constantly in mind. After the depths were determined the grades were fixed, care being taken to keep the top of small sewers discharging into larger ones level with the top of the larger ones, or a little higher where possible. The sizes of the sewers which do not take surface water were then calculated by Weisbach's formula, and the storm water sewers by the formula proposed by J. W. Adams. Although Weisbach's formula is much used in sewer calculations, it does not strictly apply. The formula supposes that the water enters at one end of a pipe and discharges at the other, while in a sewer the liquid enters the whole length of it. There is also the matter of minimum grades. Writers on sewer construction give lists of grades to secure a given velocity, on the supposition that the pipe runs half full, while the truth is that the upper ends of small sewers have only a very small stream drizzling through them, with much less than the theoretical velocity due to the given grade.

The writer's greatest tribulations have been in the rebuilding of old drains. They are annoying from the sewage found in them, and the constant discharges from house drains, and also from demands of lot owners who have usually small dry stone drains connecting their cellars with the old sewer. They insist that these stone drains be connected with the new sewer. They get in the trenches, in the way of the workmen, and stand and measure and argue as to the proper pieces of pipe they need to make the connection. If their house drain is choked with earth, and you miss it and do not leave a Y branch exactly opposite to it, then the flood-gates of wrath are opened wide. My experience teaches me to avoid the rebuilding of old drains.

The following is a list of the lengths, sizes, depths and percentage of rock in sewers:

Length.	Size.	Depth.	Per cent rock.
788	24 inches.	7 feet.	0.0
462	18 "	6 "	0.0
1,094	15 "	7 "	5.0
485	12 "	8 "	5.0
1,354	10 "	8 "	15.0
6,615	8 "	7½ "	
728	6 "	6½ "	8.0

The contract was let for a lump sum of $11,500, or about one dollar a foot. There are three Y branches to each 100 feet of sewer. There are eighteen lampholes and sixteen manholes. The manholes are built of stone taken from the trenches and covered with a cast iron cover. The lampholes are made of vertical pipe, covered with a cast iron cover. The present prospects are that the contractors will make a reasonable profit.

I have written this paper to call attention to the provisions of the New York sewer act, and also to the method of making sewer maps by co-ordinates, using two long streets at right angles, or nearly so, as co-ordinate axes. *O. C. Gillett.*

* * *

CURRENT INFORMATION.

MUNICIPAL MATTERS AT THE NATIONAL CAPITAL.

The recent cold spell created considerable activity in municipal matters in Washington, and it is predicted that a great reform will grow out of that frigid period to somewhat compensate for the many annoyances and inconveniences put up with by citizens here.

The cold weather seemed to affect nearly every department of municipal work. The quality of the gas produced a good deal of profanity. The freezing of water pipes was equally productive of a loss of religion, and consequent to this were fines imposed for wasting water, upon householders who preferred to let the water run, than to patronize the opulent plumber, and last, but not least, the garbage contractors and street sweeping contractors, came in for their share of vigorous criticism.

The quality of the gas during the cold spell was notably so inferior that it has led to no end of comment, and it is very likely that it will become the subject of congressional inquiry; in fact, Senator McMillan, chairman of the district committee, has already been authorized to investigate as to whether there is ground for the complaint which has been made, with regard to not only the quality of the gas used in the city of Washington, but the price paid for it. Senator Spooner and others held a lengthy inquiry into these matters some time ago, but no report was ever made to the Senate, nor was action taken. The inquiry into the matter is now to be taken up with the question left off, and an attempt will be made to secure a report at this session.

The Washington Gas Company, on the other hand, declare that the gas is better to-day than ever before. The gas company's inspector of lamps says that the complaints as to faulty street illuminations ought not to be laid to the quality of gas. The same trouble, freezing in the service pipes, has worried the people of other cities, and is worrying some of them still. He thinks that his company has succeeded admirably, and he can only find nine lamps out of 5,600 on which to base a complaint. During two weeks of the extreme cold weather, the gas company used fifty gallons of alcohol daily in cutting out the frost from street lamps.

It is now proposed that penalties be imposed upon the gas company for defective municipal lighting during the recent cold weather, and the committee will give the Washington and Georgetown Gas Light Company a hearing respecting this matter.

Another piece of legislation, which has been hurried by recent cold weather, was the passage by the Senate of the bill providing for the removal of snow and ice from the sidewalks and gutters of the city by the owner or tenants of each house or other buildings or ground within the first four hours of daylight, after every fall of snow. It must be removed entirely, under penalty of $1.00 for each lot, for every such neglect. If the sidewalks are covered with ice, they must be strewn with ashes, sand, sawdust, or some other substance which will insure the safety of pedestrians. If the owner or tenant fail to remove snow or other obstructions from the sidewalks, the commissioners are empowered to have it done, and assess the cost as a tax against the property.

It is stated that during the past thirty days more than 1,700 permits have been issued by the District of Columbia, for opening streets to repair water-pipes that have frozen and burst. It is claimed by some that the latter result is due to the negligence of the water department in not requiring such pipes to be "laid at a depth of not less than thirty-six inches below the established grade," as the law requires. It is estimated that not less than $100,000 have been expended in repairing frozen pipes. Each citizen, in order to obtain a permit to open a street for repairing a leaky pipe, is required to pay a charge of $1, which tax has created a good deal of vociferous dissatisfaction, and the water department has come in for considerable censure. It is argued that instead of profiting by past experience, this department continues to allow these broken pipes to be relaid just as they were before, to be frozen again the first cold snap. In this connection the manner in which the south approaches to the Aqueduct Bridge were constructed and re-constructed by an army engineer, after they had washed away, was recalled. These approaches, which are some 400 feet in length, are constructed with paved cobble-stone gutters on each side, between the carriage-way and a plank foot-walk. As first constructed no provision was made for carrying off the water during a flood or heavy shower. The result was that during the great flood of June 2, 1889, the gutters and foot-walks washed away, plowing a great gully hole down fifty foot embankment to the river and low ground below.

Instead of profiting by this experience, the engineer in charge of the bridge rebuilt these approaches exactly as they were before, to be washed away again by a thunder shower just one month after the June flood. They were then constructed properly as they should have been at first, with a great mid-grade at the gutter, and chutes each side of the gutter to carry the water down the embankment.

One gentleman said the other day that it is no exaggeration to say that more than $3,000,000 has been squandered during the past ten years, on public works in the District of Columbia, by army engineers. One item consisted of $2,570,279.39, which was buried by army engineers in a four-mile tunnel, abandoned as worthless.

A. I. P.

Washington, Feb. 18, 1893.

OPINIONS AS TO THE MERITS OF PAVEMENTS.

In a paper on the subject of street paving read before the Engineers' Club, of Kansas City, recently, Mr. John Donnelly, city engineer, referring to opinions as to the best kinds of pavement, said:

"Macadam will last as long as you repair and take care of it. Cedar blocks on concrete will continue in fair condition for five years and with some attention and sprinkling and repair it may answer for service for four years longer. Cedar blocks on boards will last about four to seven years, when it gets beyond repair and must be renewed. Cypress blocks, about three years; the material appears to rot and becomes very bad a short time after being laid. Colorado sandstone, under heavy traffic, about five to ten years, at which time, if relaid, using some new blocks, it will last an equal period. Granite blocks will ordinarily need relaying in fifteen years, but is the only kind that will endure heavy city traffic.

"Brick, if of the right kind, will endure under ordinary traffic about ten years; on narrow streets under heavy traffic, it can hardly last that long. Of the durability of asphalt, I am not as well prepared to speak. The city of Washington, among the first to pave with asphalt, is still using streets paved more than fifteen years ago; although portions of it have been patched and repaired, no general reconstruction of the streets has been made. Our neighboring city of Omaha has pavements in fair condition after ten years of wear, and while seamed and cracked from shrinking of the wearing surface, are apparently good roadways and can yet be cleaned fairly by a street sweeper, and are as good for general travel as when first laid down.

"In conclusion, the paving question is not settled, and quite likely never will be. The city of Paris removes asphalt to put down wood; the city of London removes granite to replace it with asphalt; the city of New York covers her granite or trap (basalt) blocks with a sheet of asphalt to deaden the noise, and Chicago and St. Louis keep on putting down granite blocks, as if there was no other suitable material on earth, and the more noise you have the better. A number of interior cities, from Columbus, Ohio, to Lincoln, Nebraska, use brick and think there is no better material to be had, and in those cities fortunate to have parks and boulevards such highways paved with macadam and gravel are the best and safest driveways on earth. Finally, we will try to pave and repave our streets with material the choice of the men who pay for it, and trust they may become educated to know what is best."

INDIANA ENGINEERING SOCIETY.

The annual session of the Indiana Engineering Society in the office of the city engineer of South Bend was well attended, and there were a number of papers of more than ordinary merit presented. Frank Hodgman, of Michigan, gave a detailed and very graphic description of his work as locating engineer for some Rio Grande lines in the mountains of Utah. Some of the most difficult problems encountered by railroad engineers were detailed in an interesting manner. Wm. Whitten read an article on Heterodoxical Methods in Sewer Construction, which drew out considerable discussion because it was not in accord with the established order of things (as is indicated by its title). Mr. Whitten has the courage of his convictions, however, and is putting his ideas into brick and mortar. A paper by M. A. Howe entitled Diagrams of the Velocity and Discharge of Water Flowing in Circular and Egg-shaped Conduits, called out a discussion or debate on the reliability of the generally accepted formulas for the flow of water. Other papers of more or less merit were read by members. There is one characteristic of this year's work which distinguishes it from that of former years, and that is a tendency to a more exhaustive consideration of special subjects rather than an attempt to cover the entire field of civil engineering. Legislation was let severely alone. An impression has obtained a foothold in some quarters that the society is an organization for the purpose of increasing the work and fees of county surveyors and city engineers, but there is no ground for the belief, as is shown by the fact that in the new constitution of the society the Committee on Legislation does not appear in the list of standing committees. Since the remarkable exhibition of animosity toward civil engineers displayed at the recent road congress, those men who are engaged on public works throughout the state have seen, as they never saw before, the absolute futility of attempting to convince the public by argument and reasoning that all civil engineers and all civil engineering are not to be measured by the standard of the local surveyor and his work. Possibly at some time in the future the public will recognize the value of special knowledge in municipal work as it now recognizes it in medicine or in law.

Some changes were made in the constitution which will no doubt be effective in widening the influence of the society. Five years of active practice is made the minimum for members, but a credit of three years is given on account of a professional diploma from a reputable engineering or technical school. Other changes of importance, which can not be detailed here, were made. W. M. Whitten was chosen President; C. G. H. Goss, Vice-President, and W. P. Carmichael, Secretary. The plan of the next meeting has not been decided upon.

REQUIREMENTS AS TO WIDTH OF TIRES.

A tire ordinance has been passed by the city councils of Philadelphia, applying especially to omnibuses. It regulates the license as follows: For an omnibus with its passengers which does not weigh more than 4,000 pounds, $75; if the weight be between 4,000 and 5,500 pounds, $100; between 5,500 and 7,000 pounds, $150; over 7,000 pounds, $200; and no license shall issue for an omnibus which shall, when loaded, exceed 11,000 pounds. The ordinance provides that all omnibuses running on streets paved with asphaltum shall be provided with flat tires of width as follows: For vehicles between 4,000 and 5,000 pounds, 2½ inches; between 5,000 and 6,000 pounds, 3 inches; between 6,000 and 7,000 pounds, 3½ inches; and for omnibuses weighing, loaded, 7,000 pounds and upward, 4 inches. The penalty for the violation of this provision is a fine of $100 for each and every offense. The ordinance is meant to apply only to omnibuses running regularly and continuously over the streets of the city.

SOME RECENT INVENTIONS.

A Street Sweeper. 490,188. Jacob Edson, assigned to Edson Manufacturing Company, Boston, Mass. This invention comprises a frame and rearwardly projecting brush-supporting arms secured thereto, a driving-shaft bearing provided with tubular extensions, and a truss secured to the frame and to the tubular extensions of the driving-shaft bearing whereby the brush is supported and adjusted.

A Sewer Well and Grate. 490,301. Countcil Munson, Utica, N. Y. This invention comprises a circular sewer well and a curb section having a vertical grated curb face, spanning the circle of the well and curb section of a form whereby a portion of the top of the well is exposed and a part is covered by the section, the curb section being rotatable on and independent of the well, to enable the curb face of the curb section to conform to the curb line of the street without reference to the well.

A Furnace for Burning Garbage. 490,582. William McClave, Scranton, P. This invention comprises a furnace, a central stack mounted on its top and constructed with a circular combustion chamber in its base and concentric with the stack, a plurality of lateral combustion chambers in communication with the circular combustion chamber, and a system of passages and channel-ways for supplying heated air to facilitate combustion and also passages inclosed by suitable reservoirs or tubes for the introduction of the offensive substances into the furnace to be burned.

A Wood Water-pipe. 490,892. Melford D. Arms, San Diego, Cal. This invention comprises a wood pipe constructed of suitable staves having beveled edges, and formed exteriorly with circumferential grooves, in combination with a continuous covering of wood veneerings secured to the pipe by a cement coating, and a spring band or clasp surrounding the pipe within the grooves.

A Sprinkling Machine. 490,900. Walter A. Collins, Tullytown, Pa. This invention comprises a revoluble truncated cone-shaped casting, an axis, a water-deflecting disk secured to the casing at or near the discharge end disposed at a substantially right angle to the line of the axis, a water-nozzle discharging within the casing and means for revolving the casing.

A Pipe Coupling. 491,299. Axtel S. Vogt, Altoona, Pa.

Cement. 491,280. Bernard Dreyfuss, New York, N. Y., assignor to Rosa Dreyfuss. This invention comprises pulverized spent lime, pulverized carbon, silica, oxide of iron, alumina, lime and magnesia; and slacked rock-lime and sand.

A Safety Gate for Drawbridges. 491,177. Adolph Hoeffler and Frank L. G. Chapman, Stevens Point, Wis. This invention comprises a pivoted drawbridge and a flexible safety wound upon a shaft and adapted to be closed by the bridge, a locking device to hold the gate closed, a releasing device attached to the bridge and adapted to trip the locking device in whichever direction the bridge may be turned in closing the draw, and an automatically operating winding-up device permanently connected with the gate.

A Road Scraper. 491,565. James F. Kimball, Tilden, Maine, assignor to the Western Wheeled Scraper Company, Aurora, Ill. This invention comprises a carriage having a front steering axle, a suspended scraper blade, a shaft geared to and driven by the front steering axle, and a lifting mechanism geared with the shaft and connected with the scraper blade for lifting the latter by the rotation of the front steering axle.

An Apparatus for Cleaning Sewage, etc. 491,796. William Birch, Manchester, Eng. This invention comprises a series of settling tanks or compartments in juxtaposition on the same level, the partition walls being lower that the sides, each tank or compartnent being provided with a false bottom, a sludge escape-cock or valve below the false bottom, the latter being formed of two planes inclined upwardly towards one another and having an opening at their apex, the opening being provided with an automatically closing flap and the planes being provided at or near their lower edges with small holes, the total area of which is less than the area of the sludge escape-cock or valve.

A Street Sweeper. 491,555. Hale E. Hawk, Alliance, O. This invention comprises a framework having vertical guides, upper and lower sprockets, broom-carrying belts mounted on the sprockets and means for operating the sprockets, and an axle, boxes for the same mounted in the guides, wheels mounted on the axle, a lever pivoted to the frame and provided with a locking means, a bell-crank mounted in the frame, a link connecting the same with the boxes and a connecting rod between the bell-crank lever and the first mentioned lever.

V. H. Lockwood, Patent Att'y.
Indianapolis, Feb. 20.

PIPE LAYING IN THE RIVER MAAS.

Something novel in water pipes is being laid across the river Maas at Rotterdam, Holland. The distance is about 3,000 feet, and the laying of a rigid pipe under the conditions involved was almost an impossibility. Therefore, a flexible tube was constructed, composed of short pieces connected with ball joints. Each pipe is 23.5 inches in diameter and 0.4 inches thick, made of mild steel and provided with steel flanges. The ball unions are cast-iron; outside diameter, 1,350 mm., or 4.5 feet; weight, about 2,300 kilos, or 2.26 tons. To sink the tube two barges are fastened together, and between them is constructed a wooden inclined platform of about 120 feet in length, and one end of which hangs in the furrow made in the bottom of the river to receive the pipes. The tube is built up on that platform, one end of the pipe being made fast on the bank. Afterward the barges are pulled back so far that there is room enough on the platform to put on another length of pipe with its ball joint, and so on. The length of one pipe with union is about 29.5 feet. The depth of the river is about 36 feet. The work has progressed rapidly each day, about 85 feet being laid.

ESTIMATES FOR PUBLIC WORK IN CHICAGO.

The public works department of Chicago, Ill., asks for $5,969,135 for use in the coming year. Of this amount $1,845,637 is appropriated for streets, with $887,442 of this to be expended for street cleaning.

Bridge construction calls for $1,014,447; sewer construction and maintenance, $308,320; Chicago harbor, $262,100; new pumps at the canal pumping works, $105,000. The street cleaning estimate is based on a cost of $22.50 per mile for sweeping and cleaning 3,437 miles of improved streets for nine months, making a total of 30,933 miles. For cleaning 26 times a year 193 miles of macadam streets, a total of 5,618 miles, the estimated cost is $25 per mile for the total mileage.

MUNICIPAL CONTROL OF FRANCHISES.

There seems to be a rapid growth of sentiment throughout the country in favor of municipal ownership of electric light plants. In Kansas City, Mo., the question is being agitated very vigorously by the press in favor of the idea, as far as that city is concerned, and in many other places and in various states the same subject is receiving popular consideration.

GOOD HEALTH OF SEWER WORKMEN.

Paris employs about eight hundred men to keep her sewers in repair, and these spend almost every day of the year under ground. Dr. Richardson, an English physician, who has investigated the matter, states that these men are as healthy as the average person, and no other eight hundred men in that city are so free from zymotic diseases as they.

NEW YORK CITY'S WATER SUPPLY.

The daily water supply of New York City now amounts to 171,000,000 gallons, as against 116,000,000 gallons, the daily supply prior to the completion of the new aqueduct. The full capacity of this aqueduct is over 400,000,000 gallons daily, but there is not yet sufficient storage capacity to provide this quantity.

PERSONALS.

Mr. George Bowers has been appointed city engineer of Lowell, Mass.

Mr. George S. Webster has been appointed chief of the bureau of surveys of Philadelphia. He has been connected with the bureau of surveys for sixteen years.

Gen. James C. Duane has been re-elected president of the aqueduct commission, New York City.

Mr. G. M. Eldridge has been reappointed city engineer and superintendent of water-works of Americus, Ga.

Mr. Samuel M. Gray of Providence, R. I., is making plans etc., for a sewerage system for Meridian, Miss.

W. H. Patterson and A. E. Demange are at the head of a project to construct an electric railway between Peoria and Pekin, Ill.

Mr. O. Wolff, C. E., of Copenhagen, Denmark, is visiting this country to investigate the various sewerage and water-works systems.

Mr. James K. Wilkes, city engineer of Willimantic, Conn., has resigned to take charge of the construction of a sewerage system at New Rochelle, N. Y.

Mr. Dion Geraldine, formerly superintendent of construction of the World's Columbian Exposition, has been appointed city engineer of Chicago in the place of Mr. L. H. Clarke, resigned. Mr. Bernhard Feind has been engaged as consulting engineer for that city.

The following officers have been elected by the Engineers' Club of Philadelphia: President, John Birkinbine; vice-president, James Christie; treasurer, T. Carpenter Smith; secretary, L. F. Rondinella; directors, Henry J. Hartley, John L. Gill, Jr., and W. B. Riegner.

At the tenth annual meeting of the Civil Engineers' Society of St. Paul, the following officers were elected: President, Geo. L. Wilson; vice-president, J. D. E. Slabrook; secretary, C. L. Annan; treasurer, A. O. Powell; librarian,

A. Munster; representative on the board of managers of the Association of Engineering Societies, C. J. A. Morris.

The officers of the Engineers' Club of Minneapolis, for the ensuing year, are: President, F. W. Cappelen; vice-president, John M. Hazen; secretary and treasurer, Elbert Nexsen; librarian, A. B. Coe; board of managers of Association of Engineering Societies, W. A. Pike.

At the thirteenth annual meeting of the Engineers' Society, of Western Pennsylvania, the following officers were elected: President, Max J. Becker; vice-president, Thomas H. Johnson; directors, Walter E. Koch and Emil Swensson; treasurer, A. E. Frost; secretary, R. N. Clark.

The following have been elected officers of the Montana Society of Civil Engineers: President, W. A. Haven, of Helena; vice-presidents, J. S. Keerl, of Helena, and Prof. A. M. Ryon, of Deer Lodge; secretary, G. O. Foss, of Helena; treasurer, A. S. Hovey, of Helena; trustee for three years, F. McRae, of Helena.

The Columbian Engineering Society of Washington, D. C., has elected the following officers; President, Francis R. Fava, Jr.; vice-president, W. G. Steward; secretary, F. W. Hart; assistant secretary, J. S. Pendleton; financial secretary, C. C. Jones; librarian, W. H. Aspinwall; additional members of board of directors. F. L. Averill; F. G. Perry and J. Meigs, Jr.

LETTERS FOR THE PUBLIC.

HINDRANCES TO EFFICIENT PUBLIC WORK.

To the Editor of Paving and Municipal Engineering:

SIR—One of the serious drawbacks to building good streets is the amount of "red tape" involved and political influence in selecting inspectors—the former in the nature of boards or councils, then the engineer and inspector. Although the specifications are as strict on the contractor as it is possible to make them, yet it is necessary to have all these officials to see they are properly carried out. Here is where the first "rub" occurs. They all have different opinions founded mostly on theory. The inspector is a man who gets his position through influence, not because he is capable of serving in this capacity, but because he thinks it is a "snap." And if he finds no real cause to "kick," why then he "kicks" on general principles, just to make the property owners think the contractor is robbing them, and he doing his best to keep him from it. Then the "chronic kicker" takes it up. He is ubiquitous; you find him everywhere. Generally he is not a property owner on the street in question, but a provident nature has made him to look after other people's business and see they are not imposed upon. Then the daily papers take it up; they put the contractor on a spit, turn him over and roast him to their own satisfaction.

What are the other two parties doing? As the board or council know about as much concerning the matter in hand as the others, they generally side with them and to give dignity to their office lend their voice to the uproar. And the engineer, the only real knowing one, has to keep still and look on. If he wishes to do something, it has to have the sanction of the board or council, so practically his hands are tied.

How about the contractor? He is disgusted by this time and edges out the best he can. While they wrangle over trifles, he slights important matters and comes out ahead in the end.

How can this be obviated? By giving the engineer full control. Let him choose his assistants, and make him give sufficient bond to impel him to fill his office conscientiously. Make the contractor guarantee his work for specified time, and give bond for the same. And do not regard him as only little better than a common thief, but let him think the public considers him a man with just a particle of honor left, and that he takes some pride in doing his work in a manner that will be satisfactory to the public and a credit to himself. Nine out of ten will do it about right, for on their reputation depends their future work. No man can serve more than one master without discord, and a contractor is no exception.

The above has brick streets in view, and cities where they are being introduced as a new thing.

And such is the case as I have seen it. *F. W. Cerny.*

Columbus, O., Feb. 8, 1893.

NATURAL ROCK ASPHALT *VS.* TRINIDAD PITCH COMPOUNDS.

To the Editor of Paving and Municipal Engineering:

SIR — There is a paradoxical French proverb which says that "some dead men must be killed over again."

I just arrived here from Paris, en route for Chicago's World's Fair. I read in your issue of this month (what clear type, what excellent paper) another letter from M. Julius Schubert, repeating some of his old calumnies and blunders, and must, therefore, reaffirm that your honorable townsman, Mr. Gibson, did not receive information from me in order that he might disparage "American products," or laud French asphalt.

How Mr. Gibson obtained his information concerning asphalt roadways in France I do not know, but Americans are always well received in Paris and details readily obtained from the courteous town officials, as shown by the interesting report of Major Howard in your last issue. I am not the man to pay writers to attack American competitors, particularly after receiving their kindness and hospitality. So let Mr. Schubert prove his statements or withdraw them.

The roadway laid in Paris under Mr. Schubert's management was not "American asphalt," but a compound of Trinidad pitch (a British product), on French sand and powdered limestone—it broke up as Mr. S. owns.

The natural asphalt laid by me, in continuation of the above failure, is there to-day, Rue de Rivoli, between the Rues des Archives and Renard.

Mr. Schubert, as he truly says, has much to learn about asphalt, beginning at its name. One thing is that four lines of rails in a roadway increase the cost of maintenance thereof—there are then ten joints instead of two. I did not refuse the job; in fact am bound by my contract to the last, as ordered, but I did ask for extra maintenance. However, Mr. Schubert rushed in where I feared to tread, and had a fall.

I have just finished a little book on asphalt. As soon as it is printed I will send you a copy for your correspondent; it contains a few facts which may be useful to him in case he be entrusted with another Rue de Rivoli job. The figures given of natural asphalt surface in Berlin, Paris and London are official. My company, as originator of the compressed asphalt industry, supplied the workmen and tools, and continue to supply the rock.

W. H. Delano.

Paris, Feb. 15, 1893.

QUESTIONS AS TO GRADES OF STREETS.

To the Editor of Paving and Municipal Engineering:

SIR—Something might be said as to the best mode of establishing the grade at the corner of blocks where the streets meet at right angles; also, where they meet obliquely. In side-hill towns or cities where the grade rises and falls from 0 to 15 per cent. the proper elevations at the corner of blocks is not so easily determined—property-holders all complaining at the same time. Again, where the street sidles, how far will the crown, camber, vertex or summit be from either curb, so that the grade on either side of summit will be the same? Also, how determine the elevation of points in the arc of a circle from the crown to the curb?

EXAMPLE WHERE STREET SIDLES 0.6 FROM B TO D TO FIND SUMMIT S.

Let $A\,B = a = 0.6$.
Let $B\,C = b = 42' =$ width of paving.
Let $C\,D = c = 0.6' =$ rise between curbs.
Let $D\,E = d = 0.6 = S$.
Let $S =$ summit on level with top of curb E.
Let $B\,F = S$ above gutter at $B = 1.2 +$
Let $x =$ the required distance $E\,S$.
Now, $c + 2d : b :: d : x$.

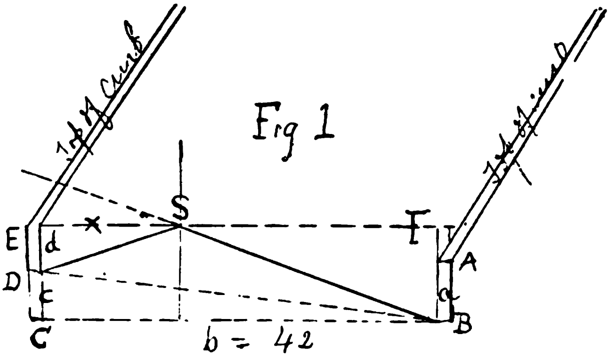
Therefore, $x = \frac{b\,d}{c + 2d} = \frac{42' + 0.60}{1.8} = 14$ ft. from nearest curb; *i. e.*, the descent from S to B = descent from S to D.

Or, $\frac{b\ (c + d)}{c + 2d} = 42 - x = 28$ ft.

TO FIND THE RADIUS R THAT SHALL PASS THROUGH THE SUMMIT S AND THE GUTTER POINTS D AND B.

$$R = \frac{(S\,F)^2 + (B\,F)^2}{2\,B\,F} = \frac{(42 - x)^2 + (c + d)^2}{2\,(c + d)} = \frac{28^2 + 1.2^2}{2 + 1.2} = 327.27.$$

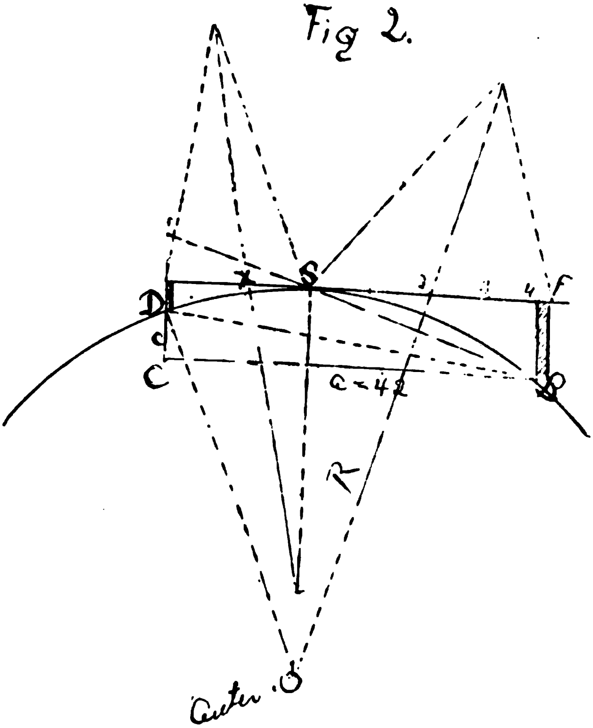
See notation, Fig. 1.



TO FIND DEPTH BELOW S AT EQUAL POINTS 1, 2, 3 AND 4 ON CURVE $S\,B$.

$\frac{B\,F}{4^2} = \frac{1.2}{16} = .075 \times 1^2 = .075 =$ depth below S at 1
$.076 \times 2^2 = 300 =$ depth below S at 2
$.075 \times 3^2 = .675 =$ depth below S at 3
$.074 \times 4^2 = 1.2 =$ depth below S at 4

Fig 2.



In other words, the offsets practically increase as the square of the distance from *S*.

F. R. Lockling.

Hannibal, Mo., Jan. 16, 1893.

A PAVING EXPERIMENT OF ARMY OFFICERS IN WYOMING.

To the Editor of Paving and Municipal Engineering:

SIR—I am much pleased with the new garb and contents of the January number of your excellent periodical. I have watched with intense interest the unprecedented growth of your magazine from its inception. The reason of its phenomenal growth, aside from the enterprise and thoroughness of its management, is the long felt want on the part of municipal and other governmental bodies for special journalism in this direction. How is one to learn without a teacher? Ignorance may be bliss under some circumstances, but ordinarily it costs its possessor very dearly, and the mission of your journal is to enlighten and instruct, and suggest those practical lessons in municipal construction, drawn from the rich experience of the few, that shall save the individual and the community many a "pound foolish," by the expenditure of a few wise pounds, and that too with added comfort and luxury of living.

A copy of your monthly publication could fittingly be placed in the hands of every constructing quartermaster in the United States Army, and it would conduce to a better knowledge in matters of post sanitation—*e. g.*, sewerage and water conduction, etc., if a limited number of copies were provided by the Surgeon-General's office for circulation with other circulating periodicals to the sanitary officers of the army—its medical corps.

I have placed your attractive January number on the post library table for the perusal of my colleague and the enlisted men of this garrison.

Apropos of the subject of paving material, let me mention a curious natural phenomenon that exists in the vicinity of this post, namely, an inexhaustible reservoir of liquid tar that continually bubbles up to the surface and by its quality of hardening on exposure to the air, has formed for itself a crater-like opening sixteen or eighteen rods in circumference, containing a pool of this liquid tar mingled with petroleum. When stirred with a stick by the wary adventurer, the pool exhibits beautiful irridescences, showing all the colors of the rainbow.

The rocks in this section of Wyoming show no evidences of vegetable remains, but contain many shells of shell-fish and vestiges of other salt water denizens, which makes it all the more strange and curious that this perennial fountain of liquid vegetable product should exist among us, like a veritable geyser, except that the flow is continuous and non-eruptive. Owing to the prodigality of nature in this region of Wyoming in the two paving materials of "tar and sand," the post quartermaster has constructed an inexpensive pavement across our parade ground out of this liquid tar mixed with fine gravel, and this walk exhibits many good qualities.

This tar spring is situated at present on an Indian reservation and is remote from a railroad, but when the reservation shall be thrown open to settlers and good facilities for transportation afforded, this liquid tar will find its way into commerce, and may yet make many a rough and crooked road straight and smooth and the weary, footsore traveler forget his woes.

I take pleasure in sending to your office a specimen of this liquid tar hardened by exposure to the air. *Henry I. Raymond,*

Assistant-Sur. U. S. Army.

Ft. Washakie, Wyo., Feb. 15, '93.

CONSTRUCTION OF PAVEMENTS ALONG "T" RAILS.

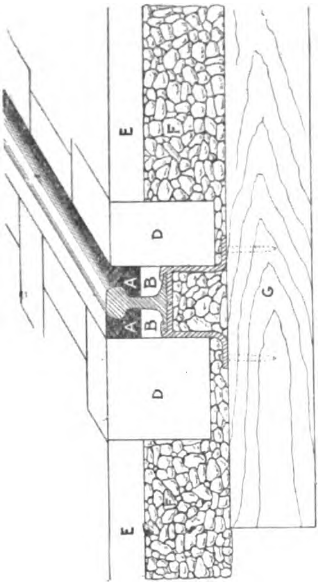
To the Editor of Paving and Municipal Engineering:

SIR—We beg to call your attention to a method of constructing pavements along the rails of street railroads, when the "T" rail is used, which, we believe, overcomes the objections usually made to that style of rail, on accunt of the dangerous spaces usually left between the rails and the pavement.

The method consists of filling these spaces with a composition prepared from genuine Trinidad asphalt, which composition when in a melted condition, is poured into the spaces and thoroughly tamped into place. Street railroad companies generally seem to prefer the "T" rail, on account of its stiffness as well as cheapness, but municipal authorities and the public almost universally object to its use, as the track is ordinarily constructed, on account of its obstruction to the wheels of vehicles. The adoption of the construction here proposed will, we believe, effectually remove these objections to the use of the "T" rail in the street railroad construction, as will be shown by the accompanying cut and explanatory statement.

Railroad tracks, constructed in this way, offer as little obstruction or danger to vehicles as the girder or any other rail, except, perhaps, what is known as the English or grooved rail.

In the summer of 1891, the Warren-Scharf Asphalt Paving Company had contracts for paving Columbia street, Utica, New York, and Main street, Amsterdam, New York. In both cases the street railroad companies desired to use the "T" rail, but, as usual, the use of that rail was strongly objected to by property-owners and city officials, on account of the danger to vehicles. At our suggestion, the construction herein described was adopted and resulted in general satisfaction to all parties interested and the method seems to be an entire success.



A A. Special Trinidad Asphalt composition, poured and tamped around the rails.

B B. Hydraulic cement grout poured around the rails to within 2½ inches of the top.

C. Iron chair; but this may be substituted by wooden stringer if preferred, provided the stringer is not so wide as to make the space between the rails and the stone paving blocks over 1¾ inches.

D D. Single rows of stone paving blocks. The rows outside the rails being laid as alternate headers and stretchers, and the inside rows as stretchers, thick and thin blocks alternating, and laid ½ inch below the rails to allow for the flanges of the car wheels.

E E. Asphalt pavement, with grade falling slightly to the curb on the outside of the rails and crowning slightly to the center between the rails. This construction is adapted to any other form of pavement as well as asphalt.

F F. Concrete foundation of pavement.

G. Wooden tie.

Portland Cement mortar and concrete have been used for filling these spaces, but have not proved successful because the material lacks the essential qualities of elasticity and malleability.

Having learned from our practical experience, the best composition for filling the spaces between the pavement and the rail, which, as ordinarily constructed, are objectionable, we have decided to prepare and offer it for sale to street railroad companies.

Warren-Scharf Asphalt Paving Co.
Utica, N. Y., Feb. 1, 1893.

ENGINEERING WORK IN PLAINFIELD, N. J.

To the Editor of Paving and Municipal Engineering :

SIR — PAVING AND MUNICIPAL ENGINEERING is just such a magazine as I have been looking for, for years, and have often wondered why some one did not step in and fill "this long-felt want."

I am by education a civil engineer, and for three years past have been street commissioner of this city. We have a complete system of grade maps for all the streets opened at the time the maps were made, viz., twenty-three years ago. These had been ignored for nearly twenty years; the result, water standing in the gutters everywhere. This has been remedied to a great extent in the past three years, but not without incurring a good deal of opposition, as people here in the East are, on principle, opposed to anything like change; yet, now that those changes have been made, they are forced to admit that they have really been benefited by them.

Wishing you all the success that you so richly deserve in your enterprise, I am, *Robt. H. Meeker.*

Plainfield, N. J., Jan. 13.

SELECTIONS FROM THE PRESS.

T RAIL PAVING.

Many arguments have recently been presented for and against the T rail, as used in paved streets. It is a fact that some companies have paved to T rail in streets of considerable traffic, with fair results. If it were possible to devise a system of paving that would give as good a surface with a T rail as it is possible to obtain with a girder rail, the use of the T rail would probably be more prevalent for city lines. The great output of girder rail, however, tends to show that it is the best form for streets when heavy wagon traffic is considered.

Some of the cities in the south and west do not restrict the railway companies regarding the shape and weight of rails to be used on their lines, and the T form has been largely used in these portions of the country. In Atlanta, Ga., the Atlanta Consolidated Street Railway Company has good T rail paving, which was laid with great care by its chief engineer, H. Nimrod Hurt. The first step in laying this track is the preliminary excavation, which in this case is about fifteen inches deep. The ground is then well rolled, ties 6 by 8 inches by 7 feet, three-corners heart, yellow pine, are placed four feet apart, and securely tamped with the soil at hand, the dirt coming flush up to the top of each tie. On the ties runs an all-heart, yellow pine stringer, 5 by 6 inches. This stringer is spiked to the ties by steel knees or braces on every tie. The rail comes finally on the 5 by 6 inch stringer, spiked at intervals of three or four inches, and is forty pound T, Pennsylvania Steel Company's make. The paving used with this construction consists of Belgian blocks laid in four inches of sand. The Belgian blocks are laid flush with the stringer, and the space between the blocks and the rail is filled by two inches of concrete (sand and Portland cement) and two inches of asphalt. Immediately after laying the asphalt, and when it is still soft, a car is run over the finished track, and the flanges of the wheels cut a groove in the asphalt just large enough for the cars to operate nicely. A car must be kept at hand for this work while the paving is being done. When the asphalt hardens it serves as a tram to the T rail.

The extra care and material used in this construction bring the cost about up to that of a girder rail, forty-five pounds, with chairs, construction and Belgian block paving. The T rail paving, described above, has been in use six months, and is standing well. One defect is noticeable, however, and that is a flange of concrete and asphalt is not as good as a flange of rolled steel. While this paving is doing quite well, it could hardly be recommended for use on a street of very heavy wagon traffic.—*Street Railway Journal.*

PAVING BRICK COMBINE IN OHIO.

That a "combine" or "trust" exists among the largest paving brick companies of Ohio has been demonstrated during the past season in making contracts for paving Zanesville streets. That some aggrieved property owners took the matter to court and were beaten in an attempt to defeat the alleged extortion is also well known, but they had little public sympathy, owing to the fact that most of them were acknowledged opponents of street improvement altogether where it affected their pocket-books. It was not so much the "highness" of the contract price. They were opposed to any paving whatever.

But the era of high prices for paving can not continue. The great profit in selling for $15 to $18 what it costs $5 to $8 to produce has led to a great many companies engaging in the manufacture of paving brick. The outlook is not favorable to a continuance of the present era of high prices. The competition is growing severe, and the "combine" is now only able to secure competitive contracts through rather questionable methods. That there was no great public indignation at the letting of the contracts in that city was probably due to the fact that the high prices were for home material, and the unpopularity of the chief "kickers," who were recognized opponents of all public improvements.

A gentleman, who is at the head of one of the largest paving companies of the state, in reviewing the situation to the *Clay Record,* in Columbus, said: "The present capacity of the various paving brick works of the country will pave over a mile per day, while the largest consumption the past season was less than half a mile per day. Thus you will see that a combine can not long exist. The end will certainly see the survival of the fittest. While it has been demonstrated that brick is the pavement for the future, the tendency of the manufacturers is to seek the best locations for good clay and cheap labor, and in this respect Zanesville is not likely to suffer. When it comes to the question of cheap production it will be impossible to haul both clay and coal to Columbus and compete, and we shall have to locate our factories elsewhere."

One of the best posted men locally on the brick question states to our representative that if the Zanesville paving contracts had not been let last fall, the same material could be purchased the coming season at a saving of at least 25 per cent., as the manufacturers are piling up stock and there is likely to be little demand for paving at the old price. —*Clay Record.*

SUPERIORITY OF VITRIFIED BRICK PAVEMENTS.

Vitrified brick is not considered as good material for street paving purposes by T. M. Symons as Trinidad asphalt. Probably no one will be surprised to hear that the gentleman recommends his own material. So far as he extols the merits of asphalt he may be given credit for the ability and earnestness of a promising salesman. For the pearls of wisdom relating to vitrified brick which he scatters so lavishly, we fear there will be nothing but swine. The vitrifying process is comparatively modern. Many of the large cities of this country have never yet tested this pavement, but wherever it has been thoroughly tested, it is considered by the best authority as the pavement of the future. Its reputation is not sustained by tickling, itching palms with the spoils of a great monopoly. It is a public improvement that has come into use at the demand of the public, and its adoption in nearly every city has been solicited only after small blocks or crossings of streets have been laid by its enthusiastic advocates, and its vast superiority thus fully demonstrated. That is the kind of argument that is convincing. One doesn't have to obtain an exclusive contract for a whole street to demonstrate the superiority of vitrified brick. Wherever this material is used, great local industries spring up, so that street paving becomes a permanent home manufacturing enterprise, furnishing as much employment and conferring a greater public benefit than shops, factories or other industries that are often bonused. This material has especial recommendations here. Fine clay is found in this vicinity. It can be manufactured and laid down here cheaply. It is superior to all other pavements for a wet climate. It recommends itself to localities where the foundation is not absolutely permanent, in preference to asphalt, on account of the ease with which it can be repaired. For this reason also it is to be preferred in any growing and improving city where sewers and street car lines may be laid, or excavation rendered necessary at any time. Good vitrified brick forms a healthful, even, dustless, smooth, noiseless, and comparatively cheap pavement, and one that is more durable and easier to repair than any other suitable for the general traffic purposes.—*Pacific Builder*.

DECENTRALIZING EFFECT OF FIVE CENT FARES.

The system of five cent fares now in use on all street railways in the United States is causing a deal of quiet thinking in Europe, where this system is little used. In England, for instance, this system is almost unknown, fares being in proportion to the distance traveled. With people who are obliged to make every cent go as far as possible these differences in fares count for considerable, consequently in a large city like London the intramural systems tend to concentrate population as near the heart of the city as possible, because of the cost of surburban fares, while the one fare system has a tendency to decentralize population. In Chicago one fare will carry a passenger a block or an average of about eight miles in any direction from the heart of the city.

European and especially English thinkers are beginning to realize that here is an American idea that is well worth adopting. A somewhat modified system to this, called the Zone system, has already come into use on steam roads in some parts of Europe. But its application is more necessary to intramural traffic in order to relieve as much as possible the congested condition of the larger cities, and this system would not accomplish as much towards decentralizing population as would the straight one-fare-a-trip system. Very few modern improvements have so benefited the cities of the United States as has the electric railway because of the facilities for rapid transit it has afforded. It has improved the health of the people by permitting them to live well out from the heart of the city, and it has made a man more self-reliant and a better citizen by permiting him to go well towards the outskirts of the city and build himself a home which his limited means could not have afforded but for rapid transit facilities and the low fare—for the electric railway could not have been the economic and commercial success it is had the one fare system not prevailed.—*Electrical Industries.*

PAVING BLOCKS FROM MAINE GRANITE QUARRIES.

Nearly all Rhode Islanders are well acquainted, through the press or personal visits, with the Westerly granite quarries. Should they visit those on the coast of Maine, they would find a great difference. The quarries here are mainly excavations in the ground, while those in Maine are simply a slow, but effectual, way of removing certain rocky hills. The Maine quarries are mostly in Carver's Harbor, Seal Harbor and Rockland. The largest plants are at the latter place. In hills of solid rock, with nothing but an occasional pine tree growing out of a cleft, the workmen drill numerous holes and blow out the blocks in any size they require. The blocks which are split into paving stones are generally cut about six feet long by three feet wide. The blocks that are bound for ports like Providence or New York are all transported by schooners. The wharves at which these schooners are docked are tapped by a tramway, on which runs a car with a drop-out bottom. Into this car a wagon load of paving stones is dumped. The car is then pushed along the tramway, which projects out over the vessel, and the bottom is dropped, and the blocks fall into the hold. In this way forty thousand blocks (a fair load for a small three-master) can be loaded in twenty-four hours. The price paid at the Maine quarries for the blocks ranges from $60 to $65 per thousand. Added to this must be the shipping rates, which are about $18 per thousand. Inclusive of labor and material, the cost of laying a square yard of paving on sand is $2.75, with concrete bottom from $4 to $4.25. The city has been so well served by the contractors that they have not only made good their agreement, but have furnished 300,000 blocks in addition. So far the city has laid this year 1,700,000 blocks, covering 80,000 square yards, and has about 100,000 now on hand.

Men who work in the Maine quarries make very fair pay, averaging $75 per month the year round. They work by the job, and the present rate at Rockland is $22.75 per thousand blocks. Once in a while some of the strikers at Westerly who own pieces of land on which they run diminutive quarries all by themselves, have a few thousand blocks to sell. These are quickly bought up. — *Providence Bulletin.*

THE IMPROVED WELSBACH INCANDESCENT GAS LIGHT.

It will be in the recollection of our readers that considerable interest was aroused a few years ago by the introduction of the new system of incandescent gas lighting devised by Dr. Auer von Welsbach. The merits of the new light were duly appreciated, and it was employed in a great number of establishments; but practical experience of its use revealed certain defects which militated against its very general adoption. The chief objection to the system was one which struck at its vital principle. The mantle of refractory material by which the light was produced was found to be too fragile, and its life too short, to enable consumers to realize the full economy claimed for it. These drawbacks were fully recognized by the inventor of the light and by those who were endeavoring to make it a commercial success; and they very prudently turned their attention to the removal of them. The result has been the production of a mantle which, as far as we have been able to learn, is much more satisfactory than any of its predecessors.

The improvements that have been effected in the system will be manifest from the following figures: When the Welsbach burner was first brought out, the light obtained from it with a consumption of 2.75 cubic feet of gas per hour was from 20 to 25 candles, or an average of 8 candles per cubic foot. Now, with the same quantity of gas a light of from 50 to 60 candles is produced, or an average of 19 candles per cubic foot. This improved lighting power is due to the changes introduced into the method of manufacturing the mantles; one of the principal ingredients with which they are impregnated being subjected to a delicate chemical process which heightens their luminosity. With regard to their durability—a very important point—great advance has been made in this respect. The mantles produced under the old process would not last more than 800 hours—that is to say, for doing really good work. After having been in use for this period, their efficiency decreased considerably. Those which are now being made have, we are informed, burnt for upwards of 3,000 hours with a loss of not more than 25 per cent.

This long life is not, however, claimed by the exploiters of the light (the Incandescent Gas Light Company, Limited) as general; 1,000 hours being estimated by them as the duration of the mantle for practical purposes. We learn that the improvements which have been effected in the Welsbach system have resulted in a marked extension of incandescent gas lighting in Austria, where it has received the serious attention of all interested in the supply of coal gas; and the result has been to counteract to a very large extent the adoption of electric lighting. In fact, several large installations of the latter system in Vienna have, we understand, been discarded in favor of incandescent gas lighting, with which nearly every establishment of any importance is now illuminated. It is only during the present year that the above-named company have been able to develop the improved Welsbach system in a practical form in England; but the success which has already attended their efforts in this direction shows unmistakably that the changes made have produced a light which is giving great satisfaction.

Of course, it is not for a moment proposed on behalf of the company—it would be useless to do so—to put forward the Welsbach incandescent burners in competition with the large gas lamps of the regenerative type which are now so largely and so effectively employed for shop as well as private lighting;

but, apart from these, it would, we think, be difficult to find in the market any system of gas lighting possessing the special qualities of economical and efficient illumination, combined with hygienic advantages, which are claimed for the Welsbach light as now manufactured.—*London Journal.*

COST OF OPERATING ELECTRIC STREET RAILWAYS.

What does it cost per car mile to operate electric lines? All the way from seven to twenty-one cents. We find in the west quite a number of lines on which trail cars are run that are operating for seven cents, others for ten, and one line where very long, heavy, single cars are operated for thirteen cents. These estimates include every expense except interest on the bonds. In some cases we are surprised to find that electric cars are operated more cheaply than cable cars under the same conditions. The pay of conductors and motormen ranges from fifteen to twenty cents per hour. One system pays twenty cents an hour for men; $1.50 a ton for slack coal, and shows a result of seven cents. Another pays seventeen cents an hour for help, $1.75 a ton for coal, or $2.60 per 100 lbs. for oil. On this railway the traffic is cared for by eight wheel cars, four wheel motor cars with trailers and the same style of car without trailers, and the annual report shows a cost of less than ten cents per car per mile. Such results must certainly stimulate the development of electric traction.—*Street Railway Journal.*

THE PAVING PROBLEM.

All pavements seem quite faulty at
their best,
But some are not asphalty as the
rest.
—*The Electric Spark.*

MACHINERY AND TRADE.

POPULAR FEATURES IN PAVING BRICK MACHINERY.

The frame of No. 1 Bucyrus Giant machine, manufactured by the Frey-Sheckler Co., of Bucyrus, O., is so substantially constructed as to render it as "break-proof" as it is possible to make it. The gearing is exceedingly heavy, housed throughout to reduce the noise accompanying common gearing. The concaves, or barrel of the machine, is neat in construction, as well as remarkably strong. The machine is supplied with first-class friction-clutch pulley, rendering the machine free from sudden starting.

The Automatic Cutting Table, manufactured by this company, is "a thing of beauty and a joy forever" to those using them. Each movable part is driven by absolutely positive gearing, rendering an imperfect cut impossible. So great has become the popularity of this table that the manufacturers find it impossible to meet the demand. They are now building an addition to their plant, after the completion of which they will be in condition to meet their continually increasing business.

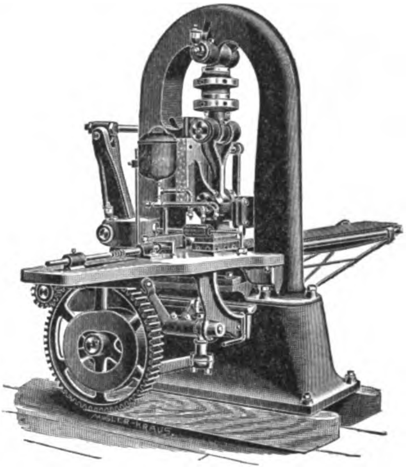
Their repressing machines are giving much satisfaction. Fine mechanics are employed in constructing these machines. Each part is "trued" and fitted to the machine before leaving the shops. The repress department of this company is kept running day and night to meet the demands of the trade. The brick are placed on the pickers, which convey them to the repressing boxes, where an upper and lower plunger grasps them and places a pressure of 95,000 pounds on each square inch of the brick. The brick are automatically ejected from the press boxes and delivered on an off-bearing belt to be taken care of by the "hackers."

The Dry and Wet Pans made by the Frey-Sheckler Company are made in three sizes—seven, eight, and nine-foot. They sold, during the year 1892, seventy-one (71) of their nine-foot drying pans, being the standard size. The seven- and eight-foot pans are exactly the same as the nine-foot pan in point of construction. The wet pans are made similar to the dry pans, except that they are provided with solid bottoms and discharge gates.

BRICK REPRESSING.

For securing the finest grades of ornamental and plain face brick, the process of repressing the brick is indispensable, and of late it is also coming into general use in the manufacture of paving brick. The advantages secured are greater uniformity in size, greater smoothness of surface, increased density and solidity, and the manufacturer can stamp his name and address or trade mark on each brick, which might prove a valuable advertisement to him. Moreover some popular patented forms of paving brick have to be repressed in order to secure the desired form and configuration. The introduction of power represses has made it possible to materially reduce the expense of repressing the brick, and also to increase the speed with which it could be done, for while with a hand press 3,000 brick is a good day's work, with a power repress 10,000 brick can be pressed daily, with the same force of hands, and with only one-half to one-horse power.

The Penfield Power Press above illustrated, combines beauty of design with unusual massiveness and strength. The pressure is exerted by a powerful toggle, arranged above the die where surplus clay from the die vents can not fall and interfere with the free action of the parts, nor does the die and die table have to be lifted each time a brick is pressed. The pressure is readily regulated, and is uniform and rigid on each brick, not being modified by or dependent on springs, which would cause objectionable lack of uniformity in the thickness of the brick.



PENFIELD POWER BRICK PRESS.

The operation of the press is automatic. After the brick is placed in position on the feed table, it is automatically fed into the die, pressed, expelled from the die, transferred to the off-bearing belt, and travels off on it. A clutch pulley is provided, placing the machine under immediate control, so that it can be started or stopped instantly. The machine has fewer parts than any other, is less complicated and easier to keep in perfect working order.

NOTES.

J. W. Penfield & Son, of Willoughby, Ohio, have issued artistic catalogues of their upright-stock brick machinery, and also of their auger brick machinery.

The Standard Dry Kiln Company, have issued a small pamphlet, giving much valuable information regarding their kiln and its uses for various purposes, together with testimonials of those who have had experience with it. The pamphlet also contains interesting information on the science of drying.

The thirty-first annual catalogue of the Frey-Sheckler Company, manufacturers of clay-working machinery, of Bucyrus, Ohio, is in print. It comprises 134 pages, is handsomely printed on fine paper, and is elaborately illustrated. The introduction states that over 4,300 brick machines manufactured by this company, are now in use in the United States at the close of 1892. The capacity of their machines used exclusively for the manufacture of structured street paving blocks was 2,560,000 daily. Over 1,940,000,000 standard paving blocks and building bricks were made on their machinery between April 1, 1892, and November 1, 1892.

IMPROVEMENT AND CONTRACTING NEWS

PAVING.

Carthage, Mo., is discussing the subject of widening her narrow streets.

Nearly $2,000,000 has been expended in Topeka, Kan., for paving and sewerage.

The Twin City Paving Company has just completed an extensive line of granolithic pavements in Bristol, Va.

There is a project in Milwaukee to build a magnificent boulevard along the lake shore from Wisconsin street to the public park north of the city limits.

Wyatt M. Keedy, clerk of Hagerstown, Md., writes that that city is expending $60,000 in street and drainage improvements in addition to the regular allowance of $8,000 per annum.

E. O. Sellers, city engineer of Lansing, Mich., is figuring on two grades—Pennsylvania avenue, 1,364 lineal feet, and Kalamazoo street, 1,700 lineal feet. Some brick work will probably be done during the coming season.

Since the Supreme Court has decreed that councils of Philadelphia have the right to admit the trolley into that city, the various street car companies are vying with one another in offering to pave streets at their own expense for the privilege of running electric cars on them.

CONTEMPLATED WORK.

Arcola, Ill., is talking of street paving.

Atlantic, Iowa, talks of paving her main street.

Delta avenue, Cincinnati, Ohio, will probably be improved.

The council of Streator, Ill., ordered $150,000 worth of paving.

Quincy, Ill., will probably pave about one mile of street with brick this year.

A considerable amount of street paving is contemplated at Black Rock, N. Y.

Albion, Mich., is wrestling with the question of paving her main thoroughfare.

There is a move to improve Division street, Portland, Ore., from Eleventh to the city limits. The work will probably be done this year.

City Clerk John McCrimmon writes that Butte, Mont., contemplates paving some of her streets.

The Commercial Club of Muscatine, Ia., is agitating the question of street pavements for that city.

The proposed great driveway or boulevard around Salt Lake City, Utah, is being favorably discussed.

Asheville, Ohio, is making preparations for the brick paving of her streets during the coming summer.

Engineer Browne, of Richmond, Ind., writes that there will be some paving done in that city this summer.

Ashtabula, Ohio, will lay about 1,300,000 paving brick this season. The cost of paving Main street will be $30,000.

A. H. Tyler, city clerk of Parsons, Tex., says there will probably be some paving done in that city during the summer.

H. M. Cooper, of Cameron, Mo., writes that that city will do a considerable amount of street work next summer.

Roe street, Dayton, Ohio, will probably be paved with brick or asphalt. There will be about ten miles of street paved in Dayton this year.

The opening of Eighth street, Davenport, Iowa, from Harrison to Main, across the large ravine that exists between those streets, is being discussed.

John W. Willard, of Jamestown, N. Y., writes that the board of public works has recommended the paving with brick of about six miles of streets.

Ernest D. Martin, mayor of Marshall, Mo., says that the committees on street work have reported favorably for the macadamizing of Lafayette and Russell streets and paving with asphalt of Arrow street.

John Mawdsley, clerk of Adrian, Mich., reports that indications point to a considerable amount of paving work this year. A small amount of brick pavement has been laid; if it proves satisfactory, more will probably be contracted for.

A. S. Fisher, of Bedford, Pa., reports that a right of way ordinance has been granted to the Bedford Electric Railway Company. If the road is begun in the spring, said company will have a considerable amount of macadamizing or paving to do.

There is a movement for the paving with brick or asphalt of South Third street, Terre Haute, Ind., from Wabash avenue to Hulman street. The plan is to have eighteen-foot sidewalks, a double row of shade trees, with grass plots on each side of the walks. The roadway will be nearly ninety feet wide.

City Engineer Chapin, of Canton, Ohio, has estimated the approximate cost of improving North Market street from Lake street to the corporation line, by laying brick pavement 34 feet wide on a crushed stone foundation, at $19,417.50; also, Eighth street from Cherry to High, by laying a brick pavement 36 feet wide on a six inch foundation of concrete, at $21,917.50; also, Woodland avenue, from Lake to Aultman avenue, by grading, curbing and laying flagstone walks, at $7,237.50.

CONTRACTS TO BE LET.

Sandusky, Ohio, will put down five miles of asphalt paving in the spring.

The Springfield, Ill., city council has passed ordinances for the paving of several additional streets.

The Cleveland, Ohio, council has arranged to issue bonds for $521,000 for paving on twenty-one streets.

S. Rushing Ryno, city clerk of Rahway, N. J., writes that street macadamizing will be contracted for July 1st.

Engineer Chapin, of Canton, Ohio, writes that bids will be received on March 13th for grading Cedar street.

Bids will be received until March 6, for the paving of First street, from East Chester to Monroe street, Monroe, Mich.

New York City will repave thirty-eight streets with asphalt and twelve with granite blocks at an expense of about $1,200,000.

Proposals will be received until March 13th for the grading of Cedar street from Marion street to Harrison avenue, Canton, Ohio.

Bids will be received until March 11, for the construction of a street pavement on Main street, between Fair and Mulberry streets, Olney, Ill.

Engineer Henry W. Scott, of Seattle, Wash., says that a number of contracts will soon be let for street improvements to the extent of seventeen miles.

George F. Fullenwider, city clerk of El Dorado, Kan., writes that forty rods of stone sidewalk, four feet wide and four inches thick, two culverts, seventy feet long, and one hundred and twenty feet of three-foot sidewalk, will be built as soon as the weather will permit.

Bids will be received by Charles L. Kinney, city engineer of Elkhart, Ind., until March 8, for grading and paving a number of alleys with cobble-stones.

Bids will be received at the office of the Cincinnati Board of Administration until March 10, for brick driveway and other improvements in Eden Park.

W. E. Gillett, city clerk of Clyde, Ohio, reports that contracts are to be let for street paving and that $45,000 street improvement bonds are to be sold.

Galena street, from Ontario street to Summit avenue, Toledo, Ohio, will be paved with brick, and Lincoln avenue, from Monroe street to Waite avenue with asphalt.

Ordinances have been passed providing for improvement of parts of Monroe, Grand, Jefferson, Newark, Madison and Garden streets, and Park avenue, Hoboken, N. J.

Sealed proposals will be received at the office of the city clerk of Sandusky, Ohio, until noon, March 18, for the paving of Market street, from Jackson to Wayne, with fire brick.

C. F. Lane, clerk of Berea, Ohio, writes that bids will be received March 6 for brick pavement requiring about 720,000 brick, 10,387 cubic yards excavation and 6,440 linear feet stone curbing.

Olney, Ill., will pave Main street between the west line of Fair street and the east line of Mulberry street. Bids will be received until March 15 for the labor and material for constructing same.

M. M. Moore, city clerk of Columbus, Ga., says that bids will be invited for paving with granite blocks or Telford macadam, three squares of Broad street, about 2,200 square yards; bids to be in by April 5.

Sealed proposals will be received at the office of the Cincinnati, Ohio, Board of Administration until March 11, for the improvement with brick pavement, granite curbing, etc., of May street to the north line of Oak street.

J. W. Sedwick, city engineer of Pasadena, Cal., reports that contracts are to be let for cement sidewalk on Maungo avenue, and grade, gutter and curb on Palmetto street and Raymond and Los Robles avenues, about one and one-half miles of street.

The Mansfield, Ohio, city council has determined to proceed at once with the paving of Park avenue west. The roadway is to be made thirty-six feet wide from Main to Sturges avenue. Beyond Sherman avenue the improvements will probably be limited to the paving of sidewalks and gutters.

S. J. Smyth, city clerk of Tacoma, Wash., writes that Pacific avenue, from South Seventeenth street to South Twenty-fifth street, is to have a pavement, 100 feet in width, of bituminous rock on a six-inch concrete foundation. A wooden pavement will be laid this summer from South Seventh to South Seventeenth streets.

F. M. Shangle, clerk of Oscaloosa, Iowa, writes that sealed bids will be received up to March 3 for the grading, cement curbing and brick paving of High avenue, from A to F streets inclusive, requiring 10,444 square yards brick paving, 1,024 lineal feet brick curbing, 2,440 lineal feet cement curbing, and 5,812 cubic yards excavation.

CONTRACTS AWARDED.

J. E. Skelly, city clerk of LaSalle, Ill., writes that F. J. Sheehey has been awarded a paving contract.

The contract for paving East Main street, Greenville, Pa., has been awarded to Hallam & Sons, Washington, Pa.

Adna Dobson, city engineer of Lincoln, Neb., writes that about $125,000 worth of brick paving has been let for the season.

W. B. Wray, of Reidsville, N. C., reports that the contract for paving Scaly, Morehead and Gilmer streets has been awarded to Lea & Co.

Abner Genier, clerk of Delaware, Ohio, writes that he has been authorized to contract with the O. S. Kelly Company for one fifteen-ton steam road-roller.

W. K. Fox, city clerk of Plattsmouth, Neb., writes that contracts for paving two blocks with brick has been awarded to Charles S. Fanning, of Omaha.

The city of Franklin, Ind., has awarded the contract to build 6,438.5 square yards of brick paved streets, to the Acme Paving and Cement Company, of Indianapolis.

The Buffalo Paving Company has a $7,683 contract for paving with bituminous rock Glor street, twenty-eight feet wide, from Austin street to Military road, Black Rock, N. Y.

Contracts were let on February 23 for reconstruction and paving with brick Fourth street from York to Brighton, and Isabella street from Fourth to Ninth, Newport, Ky.

Henry W. Scott, assistant city engineer of Seattle, Wash., sends the following information: The contract for grading and sidewalking Moltke street, from Thomas to Morse, has been awarded to W. N. White for $10,066.90. The other bids were J. A. Bailey, $10,528.56; H. M. Byerly, $11,639.56; Charles Feek, $12,861.84; Taylor Bros., $11,401.58.

Samuel J. Mann, city engineer of New Albany, Ind., writes that Contractor J. J. Huncilman, of that city, has the contract for paving three blocks of Pearl street with vitrified brick on a six-inch foundation of concrete.

The Detroit, Mich., Board of Public Works has accepted Otto E. C. Guelich's bids on 54,000 square yards of Bermudez asphalt pavement on Woodward avenue. The same contractor laid last year 25,000 square yards on that avenue.

The contract for laying all vitrified brick sidewalks until July 1, 1893, to be laid in the city of Roanoke, Va., has been awarded to Wm. McCarty. Price for paving, outside of excavations, etc., is 71 cents per square yard. The cost is to be charged to the owners of the abutting property.

Engineer Wagoner, of Huntington, Ind., writes that Jonathan Sprinkler has the contract for building 564 lineal feet of six-foot brick sidewalk on Second and Wilkinson streets at 53 cents per lineal foot, with common burned brick on a foundation of six inches of broken stone and four inches of sand.

E. H. Reed, superintendent of streets, Cambridge, Mass., reports that the following bids were received for furnishing the city with 350,000 granite paving blocks for use the coming season: Rockport Granite Co., $61 per M; Austin Ford & Son, Cambridge, $60 per M; Quincy Paving and Edgestone Co., $44.90 per M; S. & R. J. Lombard, Charlestown, $39 per M. The contract was awarded to S. & R. J. Lombard.

J. C. Tompson, Jr., city clerk of Canton, Ill., reports that Davis & Dougherty, of Bellaire, Ohio, have been awarded the contract for paving in addition to the public square, about two miles of street with brick. The bid of this firm was 54 cents per foot for stone curbing, and $1.64 per yard for pavement. The entire work, grading, paving and curbing, will come anywhere between $88,679.17 and $96,244.42 according to the proportion of Canton brick utilized.

Charles L. Harrison, clerk of Bellevue, Campbell county, Ky., says that town has just finished the original construction of all her streets and alleys. The following awards have been made recently: Anton Walters, Gas alley, excavating 19 cents, flagging 25 cents, paving 70 cents; Printers' alley, excavating 19 cents, flagging 25 cents, paving 69 cents. Samuel H. Hays, Gould alley, excavating 20 cents, flagging 24 cents, paving 68 cents; Center street, excavating 20 cents, curbing 38 cents, paving 75 cents, gravel 75 cents, flagging 28 cents.

Robert Koehler, city clerk of Rock Island, Ill., sends the following information: The Edwards & Walsh Construction Company has been awarded the contract for brick paving work to be done next summer, at $106,642.42. The work will include 6,830 square yards paving at $1.27, and 3,320 feet curbing at 54 cents, on Eighteenth street; 39,684 square yards paving at $1.31, and 14,660 feet curbing at 54 cents on Fourth avenue and Twenty-fourth street; and 12,336 square yards paving at $1.61, 6,777 feet curbing at 55 cents, and 9,886 cubic yards filling at 35 cents on Twentieth street. In addition to this, the Street Railway Syndicate will have 6,821 square yards to pave at an estimated cost of $1.40 per square yard.

SEWERAGE.

Mexico, Mo., has just completed a $4,000 sewer.

Montgomery, Ala., will construct a sewerage system.

The general plan of the proposed sewer system in Rome, N. Y., has been framed.

A system of pipe sewers, total length 3,500 feet, will be put in at Richmond, Ind.

W. J. Scott, secretary of Denison, Tex., writes that the sewer extension to Red river has been completed.

E. O. Sellers, city engineer of Lansing, Mich., says that the average cost of pipe sewers during the past season was $5.14 per foot, including man-holes.

An effort is being made to secure a new system of sewerage for Hoboken, N. J. It is proposed to build a trunk sewer through Newark street with an outlet at the Meadows.

Work has been commenced on the new twenty-four inch sewer in Chestnut street, at Rockford, Ill. It will run from Main street to the river, and most of the work will be done by tunneling.

A score or more of main sewers have been recommended by the survey committee of councils, of Philadelphia, Pa., as needed improvements on which $3,000,000 can be spent to good advantage.

A duplicate set of all the sewerage system and record of sewers in the city of Chattanooga, Tenn., has been completed by Walter C. Pool. The set consists of forty-three sheets of tracing cloth.

L. E. Farnham, of Camden, N. J., writes that owing to the cholera scare not much paving and sewer work has been done there recently. The money has been expended in cleaning the city and filling up low places.

CONTEMPLATED WORK.

Middletown, Ohio, is agitating the sewerage question.

Lake Linden, Mich., is thinking of spending $15,000 on sewers.

Oklahoma, Okl., will have a system of sewers. The city will do the work.

S. Rushing Ryno, clerk of Rahway, N. J., writes that sewer work will probably be contracted for on July 1.

City Clerk Mawdsley, of Adrian, Mich., says a considerable amount of sewer work will probably be contracted for this year.

W. H. Poorman, city clerk of Livingston, Mont., says a sewerage system will probably be adopted and contract let in the spring.

John Sorenson, city clerk of North Platte, Neb., reports that the city is figuring on the probable cost of a sewerag system.

W. J. Miller, city clerk of Ann Arbor, Mich., writes that on March 20 the city will vote upon bonds of $30,000 for the purpose of building a main sewer.

W. F. Leete, clerk of Oneida, N. Y., writes that that village will vote on the adoption of a general system of sewers. If the vote is favorable, the system may be begun the coming summer.

W. H. Wilmot, city clerk of Lambertville, N. J., writes that that city is considering the matter of a sewerage system. A commission of prominent citizens has been appointed to look into the matter, and report to the common council.

The common council of the city of Toledo, Ohio, has decided that it is necessary to construct a cylindrical brick sewer, two feet inside diameter and four inches shell, along the center line of Front street, and alley west of Oak street, from sewer No. 211 in Front street to within twenty feet of Second street.

Estimates and plans for the construction of the Capitol Hill public sanitary sewer at Denver, Col., has been prepared and submitted by Engineer Meryweather. This plan calls for the building of a sewer to form an outlet for the Capitol Hill Sewer District No. 1, and will involve an outlay of $17,300.

CONTRACTS TO BE LET.

D. P. Pickard, secretary of Greenville, Pa., reports that contracts for terminal sewer will be let in the spring.

A twelve-inch pipe sewer will be built along Sixth avenue, Troy, N. Y., for which work contracts will soon be awarded.

Geo. R. Lash, city recorder of Pendleton, Ore., writes that bids will be wanted this spring for a sewerage system for that city.

Bids will be received by Charles L. Kinney, city engineer of Elkhart, Ind., until March 22, for the construction of various sewers.

The contract for laying a sewer in Washington street, between the bridge and Front street, Spokane, Wash., will soon be awarded.

J. W. James, of Sioux Falls, S. Dak., writes that bids will be received by Roy Williams, city auditor, up to March 6, for the construction of about 68,000 lineal feet of sewerage.

Bids will be received at the office of the city engineer of Bucyrus, Ohio, until March 7 for the construction of Prospect and Wiley street sewer in sub-main sewer district No. 14, and laterals Nos. 1 and 2 of main sewer district No. 4.

E. L. Shaw, city engineer of Marinette, Wis., writes, that a general sewer system has been designed for that city, and a large amount of work will be done during the coming season. Contracts will probably be let in April. The estimated cost of the entire system is $90,000.

CONTRACTS AWARDED.

The city of Monmouth, Ill., has contracted for six miles of sewers.

Kenosha, Wis., has awarded contracts for building 4,510 feet of 42 and 36 inch brick sewers, and 21, 18, 15, 12 and 8 inch pipe sewers.

The contract has been awarded for the construction of a sewer in Southgate street, from Isabella street to the Licking river at Newport, Ky.

Thomas F. Moore, of Buffalo, N. Y., was awarded the contract for building section six of the East side sewer district in consideration of $126,000.

L. E. Chapin, city engineer of Canton, O., writes that the contract for machinery for the sewage disposal works has been let to the Bonnot Co., of Canton, for $4,790.

Contracts have been let for the construction of sewers in the following named streets at Cleveland, Ohio: Champlain, between Ontario and Seneca streets; Chatham, between Ward and Jersey streets; Clinton, between Hanover and State streets; Hancock, between Jersey and Penn streets; Irving, between Pittsburg street and a point 400 feet south of Orange street; Jefferson, between University and Professor streets; McKinstry, between Literary and Railway streets; Myrtle court, Magnet street, Ocean street, Otis street, Princeton street and Wade avenue.

Charles G. Carlson, clerk of Moline, Ill., writes that Davis Co., of that city, has been awarded contracts for about 1,315 feet of ten-inch sewer on Eleventh street, from Twelfth avenue south to Sixteenth avenue, for $1,485; and about 1,665 feet of eight-inch sewer on Sixth avenue and Twenty-third street for $650.

The contract for the construction of a system of sewers in Hoosick Falls, N. Y., has been awarded to S. B. Sears & Emonson, Kingston, N. Y., at $32,628. The other bids were as follows: F. R. & L. W. Pratt, Albany, N. Y., $33,982; Muir Bros. & Nickleson, Port Huron, Mich., $35,575; Wm. H. Berry, Hoosick Falls, $35,623.20; P. H. Harrison & Sons, Newark, N. J., $37,428; Acock & Son, Trenton, N. J., $38,321; L. & L. E. Buckley, Hoosick Falls, N. Y., $40,952; Thos. McKeown, Buffalo, N. Y., $38,735.50; Evelin & Hall, Waterford, N. Y., $40,215; M. Sullivan, Little Falls, N. Y., $44,337; Michael Bennet, Utica, N. Y., $49,709; W. B. Connell, Youngstown, Ohio, $48,101; Daniel Murray, Port Chester, N. Y., $41,664; Frank L. Allen, Worcester, Mass., $55,357; Edmund Broderick & Co., Troy, N. Y., $51,170. J. Leland Fitzgerald is the designing engineer.

J. Arthur Stevenson, city clerk of Monmouth, Ill., sends a list of the bidders on the "Northwest Sewerage System," and their prices. The contract was awarded to the Monmouth Construction Co., of Monmouth, at $22,421 36. The other bidders were: J. D. Lynch & Co., Monmouth, $22,777.88; Walker & Co., Kansas City, Mo., $29,537.89; Bick & Glann, Toledo, O., $28,132.84; Andrew Anderson, St. Paul, Minn., $35,406.85; Cooper & Dorsey, Terre Haute, Ind., $24,586.31; Simons & Boyd, Quincy, Ill., $24,739.20; Tschirgi, Kringle & Deleney, Dubuque, Ia., $23,277 88. The system includes 1,040 feet thirty-inch two-ring brick, 1,133 feet twenty-four-inch, 1,907 feet eighteen-inch, 2,506 feet fifteen-inch, 20,011 feet twelve-inch, 3,611 feet ten-inch, 1,956 feet nine-inch, 200 feet eight-inch, and 2,500 feet six-inch pipe sewer, forty-five manholes and ten catch-basins.

John W. Willard, secretary Board of Public Works of Jamestown, N. Y., sends the following information: Arrangements have been made for the sale of $50,000—3½ per cent. thirty-year sewer bonds to parties represented by Chas. H. Wicks, of Jamestown, at a premium of 3¼ per cent. On February 4, bids were received on the construction of a certain portion of the main sewer and laterals of the complete separate sewer system lately adopted by the city as follows: Rider & Fitzgerald, Dunkirk, N. Y., $80,717.47; Kelly & Sheehan, Bradford, Pa., $79,748.70; John Hadley, Canton, Ohio, $70,496.87; W. B. Connell, Youngstown, Ohio, $63,642.40; Standard Construction Company, Pittsburgh, Pa., $55,208.85; John O. Smith, Buffalo, N. Y., $52,070.90; Sloan & McElwain, Pittsburgh, Pa., $49,988.75; W. H. Roberts, Pittsburgh, Pa., $42,670.10. The contract was awarded to W. H. Roberts.

City Engineer Mann, of New Albany, Ind., writes that the contract for laying an eighteen-inch pipe sewer, 1,070 feet in length upon Spring and Pearl streets, has been awarded to J. J. Huncilman.

WATER-WORKS.

Athens, Ga., has contracted for new water-works.

Covington, Ind., will soon have a new water-works plant.

Niles, Mich., is negotiating for a $40,000 system of water-works.

Horton, Kan., is negotiating for a $40,000 system of water-works.

Water-works have been voted for at Fairmont, Ind. The plant will cost $30,000.

The city clerk of Atlanta, Ga., writes that that city is constructing magnificent new water-works.

Darius Hult, clerk of Rochester, Ind., writes that the city intends putting in water-works in a short time.

W. T. Dougherty, secretary of Oak Cliff, Tex., writes that the city expects to complete its water-works plant in the near future.

Water-works are to be built at Van Buren, Ark.; Burlington, N. C.; Crescent City, Fla.; Barnesville, Ga.; Hutto, Tex.; Bonham, Tex.; and Huntsville, Tex.

E. W. Harrington, city clerk of Crete, Neb., writes that the city has purchased the water-works property from the College Heights Reservoir Company for $35,000.

The special water committee appointed by the Providence, R. I., common council to consider the matter of purifying the water supply, advise the construction of a system of mechanical gravity filters, capable of filtering 15,000,000 gallons of water a day. The cost of this proposed system will be about $130,000, which will include suitable buildings for carrying on the work.

CONTEMPLATED WORK.

The citizens of Martinsville, Ind., have voted for water-works by a majority of 300.

N. G. Underwood, clerk of Elizabeth, N. J., says that water-works improvements are contemplated.

The water-works question is being discussed at Shullsburg, Ill.; Carbondale, Col.; Traer, Ia.; and Exeter, Mass.

CONTRACTS TO BE LET.

Hartington, Neb., is to have a $10,000 system of water-works, some time in the near future.

W. E. Gillette, clerk of Clyde, Ohio, writes, that contracts are to be let for water-works extension. Bonds for $7,000 for the purpose are to be sold.

W. H. Weaver, clerk of Watseka, Ill., writes, that the water-works mains of the city will be extended this spring. The water tower was finished last October.

Adolph Anderson, city recorder of Logan, Utah, reports that specifications are being drafted for the balance of the new water-works system, and bids will be called for.

The Mason City, Ia., council have ordered water mains put in on Adams street, from Seventh south to State; also on Main street to Ninth, and west on Ninth street.

J. E. Skelly, city clerk of La Salle, Ill., writes, that the city expects to lay a considerable amount of iron pipes for water-works. Contracts will probably be let for small quantities.

CONTRACTS AWARDED.

Yonkers, N. Y., has contracted for water-works with the New York City District Water Supply Company.

Contracts for new engines and boilers for a new pumping plant in Brooklyn, N. Y., have been awarded at $306,900.

The contract has been awarded for the construction of a water-works plant in Greenville, Ohio, to cost $79,130.38.

J. B. Carter, city clerk of Shenandoah, Ia., writes that a contract for twenty-eight hydrants and four gate valves has been awarded to the Ludlow Valve Mfg. Co., Troy, N. Y., for $675, about $100 higher than the lowest bidder.

The contract for foundation for stand-pipe and erection of power house has been awarded to Jacob Koons for $2,370. Contract for stand-pipe has been let to Riter & Conley, of Pittsburgh, Pa., and water-pipes to the Chattanooga Pipe Co.

Stevens & Bedwards, of Logansport, Ind., have been awarded the contract for putting in the water-works at Edinburg, Ind., at $16,751. The amount of pipe bid on was 3,800 feet of eight-inch pipe, 1,200 feet of six-inch pipe, 3,900 feet of four-inch pipe, and fifteen hydrants.

Seth Smith, town clerk of Provincetown, Mass., reports that the contract for laying water-pipes, etc., has been awarded to Lucian A. Taylor at $7,997.62. There were thirteen other bids, ranging in price from $8,360.68 to $13,347.20. The contract for furnishing pipe was let to McNeal Foundry Co., Burlington, N. J., for $18.500; for hydrants, to the Chapman Valve Manufacturing Co., Boston, at $1,412.17; for valves to the Rensselaer Manufacturing Co., Troy, N. Y., at $1,338.60.

BRIDGES.

Contracts for bridges will soon be let in Knoxville, Tenn.

A $60,000 bridge will be built across the river at Winnepeg, Manitoba.

Hunt county, Tex., is to have four iron bridges at a cost of $1,425 each.

A new iron bridge is soon to be built across the Republican river at Guide Rock, Neb.

Bids will be received till noon March 3 on a four-span steel bridge at Des Moines, Iowa.

The Grand Trunk Railroad will probably build a new bridge across the gorge at Niagara Falls.

There is a prospect that a big bridge will soon be built between Superior, Wis., and Duluth, Minn.

An iron bridge is to be built over the Sangamon river in Macon county, Ill. The contract has been let at $3,352.

The Kentucky Legislature has authorized the construction of another bridge between Cincinnati and Covington.

Bids will be received by the county commissioners of Plattsmouth, Neb., until March 9, for the construction of all bridges to be built by the county during 1893.

W.G.Underwood, city clerk of Elizabeth, N. J., writes that contract is to be let for an iron drawbridge over Charles creek, twenty-four foot span in the clear, sixteen foot roadway.

The award for the four track drawbridge to be built by the New York Central Railroad Company over the Harlem River, has been made to the King Bridge Company, of Cleveland, Ohio.

The board of public works of Indianapolis proposes to increase the lasting quality of the timbers in the Pogue's run bridge at Washington street, by having them chemically treated.

City Clerk Genier, of Delaware, O., writes that the bridge committee has been authorized to advertise for plans, specifications, etc., for a bridge across the Olentangy river on Central avenue.

The city of Petersburg is preparing to build a bridge over the Neva, to cost $14,000,000. The plans and specifications were drawn by M. Eiffel, the distinguished French architect and engineer.

The Montgomery Bridge Company has a bill in the assembly which has for its object the building of a bridge across the Alabama river, between Montgomery and Wetumpka. The company's capital stock will be $150,000.

Engineer L. P. Wolff has submitted drawings and figures for the proposed walking and driving bridge across the Mississippi at Red Wing, Minn. The bridge would be 2,000 feet long and 24 feet wide; the total cost is estimated at $70,000.

New York City and Jersey City people are about to build a railroad bridge across North river to be sixty feet high above the water. It will be 10,680 feet long, and the main grade will be at the rate of forty-five feet to the mile. It rises from low ground on the New York side.

The Atlanta, Ga., council invites plans, specifications, and bids, until April 1st, for the opening of Alabama street, by going over and bridging the Central Railroad tracks, and under the East Tennessee, Virginia and Georgia and the old Monroe tracks, to a point at, or near, Elliott street.

The Michigan Central Railway Company built a new iron bridge across the Kalamazoo river at Battle Creek. It was built parallel with the old one and put on rollers ready to be moved into place, and just six and a half minutes after the old bridge was cut away the new one occupied its place, so that not a train was delayed on account of the work.

The bill permitting the building of the bridge over the Mississippi at New Orleans has been signed by President Harrison. It will be the longest Cantilever bridge in America. The length of the main span will be 1,095 feet, and each end span 757 feet, resting eighty-five feet above the surface of the water, being of sufficient height to allow the largest river steamers to pass under it; the approaches will each be at least a mile long. It will be unequalled this side of the wonderful Firth bridge on the east coast of Scotland, which has three spans of 1,710 feet each. Its estimated cost is $5,000,000, and it is to be completed within three years.

Charles L. Harrison, clerk of Bellevue, Campbell county, Ky., writes that the new street car company, of which John J. Shipherd, of Cleveland, O., is president, intends building a viaduct for an electric road between Bellevue and Newport. An attempt was made to raise money by subscription for a twenty-thousand-dollar viaduct, but the plan was abandoned.

STREET LIGHTING.

The citizens of Gallipolis, O., have voted almost unanimously in favor of electric lights.

The price in Sweden of incandescent lights, with all voltages up to 125, is about twenty cents.

Three thousand gas street lamps in New York City will be replaced by 1,000 electric lights this year.

R. D. Mann, clerk of Swanton, Vt., writes that that village is negotiating for an electric light plant.

John Sorenson, city clerk of North Platte, Neb., says that city will probably have an electric light system in the spring.

F. B. Orser, clerk of Addison, N. Y., writes that a contract for street lighting by electricity has been let to F. H. Wheaton.

S. Rushing Ryno, city clerk of Rahway, N. J., writes that street and public building lighting will be contracted for July 1.

W. E. Gillet, clerk of Clyde, Ohio, reports that contract is to be let for an electric light plant. Bonds for $12,000 are to be sold for the purpose.

Thomas B. Dunn, city secretary of Corpus Christi, Texas, writes that the city's contract for street lighting expires in April and a new one will probably be made.

O. S. Norsman, city clerk of Madison, Wis., writes, that the contract for electric lighting has been awarded the "Capital City Electric Company" for three years. It calls for ninety twelve o'clock, 1,200 candle-power electric arc lights at $57 per lamp per year, and thirty-five all night lights at $87 per light per year. The other bidders were "Four Lakes Light and Power Company," of Madison; the Madison City Gas Light and Coke Company, for lighting by gas; and the Globe Light and Heat Company, of Chicago, for lighting by gas from naphtha.

Wyatt M. Keedy, city clerk of Hagerstown, Md., writes that he has been ordered to advertise for bids for electric street lighting. The present contract expires July 1.

L. E. Browne, city engineer of Richmond, Ind., says, that city is investigating the matter of street lighting with arc lamps, with the intention of securing more satisfactory light.

Ernest D. Martin, mayor of Marshall, Mo., writes that the election on February 14 resulted 789 to 71 in favor of electric lights. Franchise has been granted to Macon City Electric Light Co., of Macon, Mo., with a contract for three years for 25 arcs of 2,000 candle-power each, and 20 incandescent lamps of 32 candle-power each.

John W. Willard, secretary board of public works of Jamestown, N. Y., writes that the board has recommended to the council an addition to the electric light plant involving an expenditure of $15,000. The question will be voted upon by the city. The electric plant is under the control of the board of public works, being in direct charge of Robert Bryan, one of its members, who is furnishing the city with about one hundred and fifty 1,200 candle-power arc street lights at an average expense of less than four dollars per lamp per month.

M. M. Moore, clerk of the Columbus, Ga., council, writes that a contract has been let to the Brush Electric Light and Power Company for 102 arc electric street lights of 2,000 candle-power, at $120 each per year. There was no other bid excepting that of the Gas Light Company, proposing to furnish 400 to 600 gas lights at $15 each per year. The committee on street lights, of which H. H. Daniel is chairman, was instructed to investigate the cost of plant of 150 arc lights of 2,000 candle-power capacity with a view of having same ready by the first of January next.

PUBLIC PARKS.

The park commissioners of Waltham, Mass., are considering the expenditure of $40,000 or $50,000 in the purchase of lands for park purposes.

Mrs. S. S. Vaughn has donated a forty-acre park to Washburn, Wis. It is about 300 feet above the lake and has a gradual slope toward the bay, thus assuring perfect draining with very little expense, and what is more, gives one of the grandest and most beautiful views in the entire Northwest.

Estherville, Ia., is discussing the question of a public park.

Special street commissioners in New York have been making plans for a new street called Cathedral Parkway, which will unite Central Park, Morningside Park and Riverside Park in one continuous driveway. The road will be under the control of the Department of Parks, so that trucks and heavy teams will be excluded from it.

Minneapolis will establish a park at Sandy Lake. The plan provides for the purchase of 125 acres contiguous to the lake in question, at an average price of $1,096 per acre. The Minneapolis Improvement Company Northeast, puts in some of their land at nearly $1,000 an acre less than was paid for it, and in addition they will give out of their treasury for the immediate improvement of the park, $20,000, which will put it in very nice shape. The park board committee favors the enlargement of Powderhorn park.

STREET RAILWAYS.

Alexandria, Ind., will have an electric street railway.

Columbiana county, O., has fifteen miles of electric railway.

A franchise has been asked for an electric road at Northboro, Mass.

It is proposed to build an electric road to connect Trenton, N. J., with Newtown, Pa.

A street railway at Key West, Fla., proposes to relay the tracks and put the whole line in repair and equip the road with electricity.

The council of Argentine, Kan., has granted a franchise to the Union Terminal Company to lay tracks and operate its lines in that city.

R. W. Havens, city engineer of Dallas, Tex., writes that the city has granted a franchise for a new electric railway, which will be about eight miles in length.

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MUCH TO BE LEARNED FROM IT.

IRONTON, OHIO, January 14, 1893.

I have been a subscriber to *Engineering News*, of New York, over eighteen years, and of *Engineering Record and Building Record*, also of New York, and I felt that I had about as much as I could stand of the class of reading, yet I think you are on a line different from either of the above named journals, and will properly fill a niche in the professional literature not made by them. I have been City Engineer continuously almost twenty-two years, and I find there is much to be learned from such journals as yours certainly will be.

J. R. C. BROWN.

HIGHLY PLEASED WITH IT.

CLINTON, IOWA, January 12, 1893.

To say I am highly pleased with the creditable improvement in the form of your journal, and the interesting articles therein, and those promised in the future numbers, is but a simple expression of justice in your behalf, but I hope will aid to inspire you in the good work to further improvements in quantity and quality that your fertile brains may materialize, to make it what it deserves, the leading public municipal journal of the country.

B. B. HART.

AN EDITION OF HIGH RANK.

RICHMOND, IND., January 12, 1893.

In its present form it is a magazine that can hold its head high with just pride, as it certainly has a worthy object in view, with a broad field and few competitors in its special line of journalism. In its typographical features it possesses all the perfection of detail that is so pleasing to the eye, and admits easy reading without fatigue; in short, it will become an educator of high rank.

A. H. STUDY, C. E.

CHEAP AT FIVE DOLLARS PER ANNUM.

EVANSTON, ILL., January 15, 1893.

The enlarged magazine is a great success. I would think it cheap if the price were increased to five dollars per annum. The introduction you give the readers to the several writers is very agreeable and gives weight to the production when it is known that the writer is familiar with the subject written about.

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INTERESTS THE BRICK CONTRACTORS.

Columbus, O., Jan. 12, 1893.

Editor Paving and Municipal Engineering:

Dear Sir—The January number of your Journal received. Am greatly pleased with its new form and dress, consider it the best magazine published on the topics it embodies, being full of timely hints and articles of value bearing on my business, which is brick street paving. But this is not the only part that interests me, for I read its entire contents and profit thereby. Yours truly, F. W. Cerny.

A WORK OF ART.

Red Wing, Minn., Jan. 13, 1893.

Your magazine certainly is a work of art and does great credit to your institution and to the cause it advocates. Yours truly,

Red Wing Sewer Pipe Co.,
C. E. Sheldon, *Sec'y.*

WHERE IT HAS HELPED.

Winona, Minn., Jan. 12, 1893.

We esteem your periodical highly and it has been of much value to us in reaching a conclusion upon paving, which we are about to enter upon here.

Yours truly, C. A. Morey,
Chairman Com.

A MODEL NUMBER.

Omaha, Neb., Jan. 12, 1893.

Please allow me to congratulate you on the January number of "Paving and Municipal Engineering." It's a model number and I trust that the same excellence will be maintained.

Very truly yours,
John Grant, *Pres.*
Grant Asphalt Paving and Slagolithic Co.

MAY IT LIVE LONG AND PROSPER.

Pullman, Ill., Jan. 12, 1893.

I am much pleased with "Paving and Municipal Engineering," in its new dress. May it live long and prosper. William Lee.

INTERESTING TO MUNICIPAL ENGINEERS.

Bayfield, Wis., Jan. 13, 1893.

The new form is truly a great improvement over the other form. All who are engaged in municipal engineering will hail with delight the contributions found therein. D. F. Glover.

THE GENERAL VERDICT.

Binghamton, N. Y., Jan. 12, 1893.

I am much pleased with "Paving and Municipal Engineering." It is very interesting and instructive. Very truly yours,

S. E. Monroe, *City Engineer.*

INTERESTED IN PAVING BRICK.

Mt. Vernon, O., Jan. 14, 1893.

I am well pleased with its appearance and as brick paving has come to stay, I eagerly devour all that is calculated to throw light on that subject.

Very respectfully, A. Cassil, *C. C. E.*

APPROVED IN ALL RESPECTS.

Philadelphia, Pa., Jan. 13, 1893.

The January number of your Journal in its new form meets with our approval in every respect. It is much more attractive and convenient than the old form and we think you will undoubtedly find it a step in the right direction. Wishing you success. Yours truly, Chambers Brothers Co.,

J. H. Chambers, *Gen'l Mgr.*

WILL CONTINUE TO READ IT.

Mankato, Minn., Jan. 13, 1893.

I have received your Journal for some two years and in its new form shall continue to read it.

Truly yours, M. B. Haynes, *City Engineer.*

THINKS IT A GREAT IMPROVEMENT.

Minneapolis, Minn., Jan. 14, 1893.

Your handsome monthly in the new form is received. We think it a great improvement on the old style, and the editorial and contributed articles are interesting and valuable for preservation, and in convenient form for binding. Wishing you a large success, we remain, yours truly,

Parkhurst Paving Co.

BRIEF, BUT GRATIFYING.

Troy, N. Y., Jan. 12, 1893.

We congratulate you.

Ostrander Fire Brick Co.

LIKE ITS NEW STYLE.

Boston, Mass., Jan. 18, 1893.

We are pleased with its "new garments" and typographical arrangement.

Pope Mfg. Co.

WILL BE OF MUCH USE.

Mobile, Ala., Jan. 12, 1893.

It strikes us that you made a great improvement in your magazine and we believe it will be of much use to all parties interested in municipal work.

Yours truly,
Improved Wood Pavement Co.,
By A. C. Danner, *President.*

EVEN THE ADVERTISEMENTS ARE IMPROVED.

Philadelphia, Pa., Jan. 16, 1893.

To say there is a decided improvement in your magazine is putting it very mildly indeed. The specimen cover published in your December issue was evidence to me of a great improvement in form and taste; to me it is very taking. I was not prepared, however, for the improvements in the inside arrangements. Why, everything is improved—even the advertisements. To tell you all I think about it would seem fulsome. I really am much pleased with it and as to suggesting improvements, why, you have not left me an inch of room.

Yours truly, William Waplington.

CALLS THE ATTENTION OF COUNCIL TO IT.

Boone, Iowa, Jan. 16, 1893.

I think it just the kind of periodical needed by parties interested in that kind of work, and shall call the attention of the City Council to the matter at its next meeting. Respectfully,

W. W. Hixon, *City Clerk.*

A GREAT IMPROVEMENT.

New York, Jan. 17, 1893.

New form is great improvement. By judicious selection of best information on construction and maintenance of different kinds of road pavements—Europe is a very important source from which to draw—your paper could become the recognized authority on that subject in America.

Yours truly, Rudolph Hering,
No. 277 Pearl St.

MORE CONVENIENT FOR REFERENCE.

Michigan City, Ind., Jan. 11, 1893.

I like the new form much better than the old as it is more convenient for binding and keeping for future reference. Yours, etc., H. M. Miles,

119 E. 9th St.

ONE OF THE BEST.

Fostoria, Ohio, Jan. 17, 1893.

The magazine needs no suggestions to improve it as it already is one of the best published and the form is the best. Yours very respectfully,

Frank Gebert.

LIKES THE BIOGRAPHIES.

Everett, Mass., Jan. 15, 1893.

I am very much pleased with "Paving and Municipal Engineering" in its new form, especially the short biographies of contributors.

Yours, etc., George L. Mirick.

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GRAVEL ROAD.

The undersigned, engineer in charge of construction of gravel roads in Warren county, Ind., will, on Friday, March 10th, 1893, up to the hour of 1:30 P. M., receive sealed proposals for the construction of 8.85 miles of gravel road, the estimated cost of which is $18,114.74. The work is to be done under the law of 1877, authorizing County Commissioners to construct gravel or macadamized roads. Each proposal must be accompanied by a satisfactory bond with at least two free hold sureties, residents of the State of Indiana. In case a person making a proposal, or any surety on his bond be not a resident of Warren county, the proposal must be accompanied by certificate from the County Auditor of the county in which such person or such surety resides, showing his business and financial responsibility. For detailed estimates and additional particulars, apply to **Wm. P. Carmichael,**
Williamsport, Ind.

STREET IMPROVEMENTS.

Streator, Ill., March 1, 1893.

Sealed proposals will be received by the City Clerk of the city of Streator, Illinois, until 12 o'clock M., April 3, 1893, for the improvement of the following streets in the city of Streator, Illinois, by paving the same with brick: Bloomington street, from the north line of Main to the north line of Elm street; estimate, 5.088 sq. yds. of paving and 1,458 feet of curbing. Bloomington, from the south line of Main to the south line of Bridge street; estimate, 3,505 sq. yds. of paving and 1.038 feet of curbing. Sterling street, from the south line of Main to the south line of Bridge street; estimate, 2,746 sq. yds. of paving and 1,087 feet of curbing. Vermillion street, from the north line of Main to the north line of Hickory street; estimate, 2,000 sq. yds. paving and 736 feet of curbing. Vermillion street, from the south line of Main to the south line of Bridge street; estimate, 2.746 sq. yds. of paving and 1.087 feet of curbing. And Sterling street, from the south line of Hickory to the north line of Main street; estimate, 1,549 sq. yds. of paving and 640 feet of curbing.

Specifications of material and manner of construction to be had upon application to W. B. Burson, City Engineer. The city reserves the right to reject any or all bids. **W. B. Burson,**
City Engineer.

STREET IMPROVEMENTS.

Sealed proposals will be received at the office of the Board of Administration until 12 o'clock noon of Thursday, March 16, A. D. 1893, for the improvement of Towsend street, from Borden street to C., H. & D. R. R. street, by grading, setting curbs and crossings, flagging and paving gutters, macadamizing the roadway, and constructing the necessary culverts, drains and retaining walls according to specifications on file in the office of the Board of Administration. The same to be paid for as provided in the resolution and ordinance for said improvement. The board reserves the right of rejecting any or all bids.

Bidders must indorse their names and address upon the outside of the envelopes containing their bids.

Each bid to be accompanied by two disinterested sureties.

Bidders to use the printed forms as none other will be received.

By direction of the Board.

John Frey, Vice-President.
A. P. Butterfield, Clerk. Cincinnati, O.

SOME LEADING ARTICLES IN RECENT NUMBERS OF PAVING AND MUNICIPAL ENGINEERING.

JANUARY, 1893.

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By D. V. Purington.

FRENCH AND AMERICAN ASPHALT PAVEMENTS COMPARED.
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By Arthur Lagron, C. E.

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THE IMPORTANCE OF WIDE WHEEL TIRES.
By J. M. Heiskell, C. E.

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It is provided on the outside edge with an iron plate, which strengthens as well as protects it from wear, and breaking from contact with cart or wagon wheels, or other causes of injury. This plate, being galvanized, does not discolor the face of the curb.

In addition to this, two bars of angle iron form the front and back of the bottom of the curb, making it **Iron Bound** on THREE corners, and tie rods are imbedded in the concrete for its entire length, giving it strength equal to granite, and making it absolutely **non-breakable.**

This curb is continuous throughout its entire length, and has no joints to separate and get out of position, as the short lengths now used of the ordinary stone invariably do, after a few years of use.

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For railroad depots, wharves, piers and shipping docks, also driveways for bridges, it will prove of great benefit, and will outlast any other kind of Curbing that could be used.

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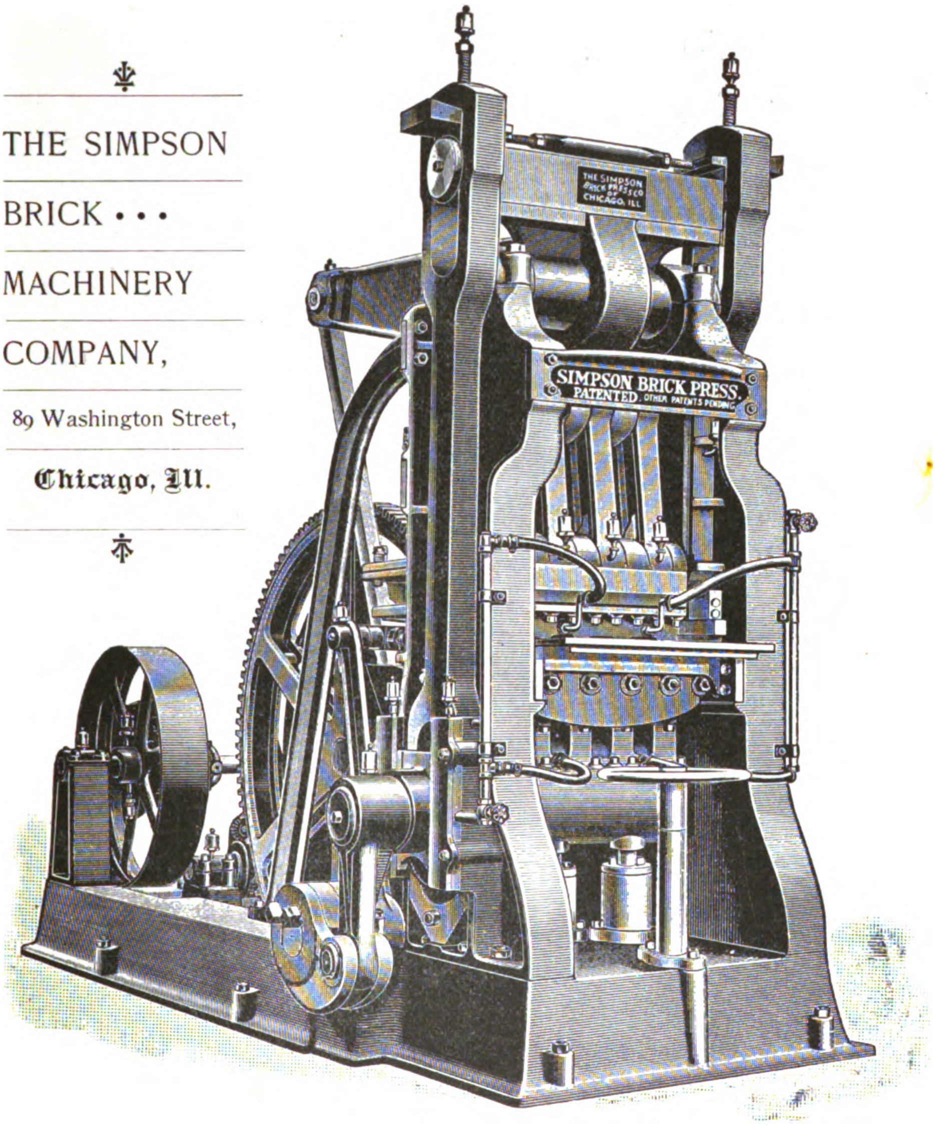
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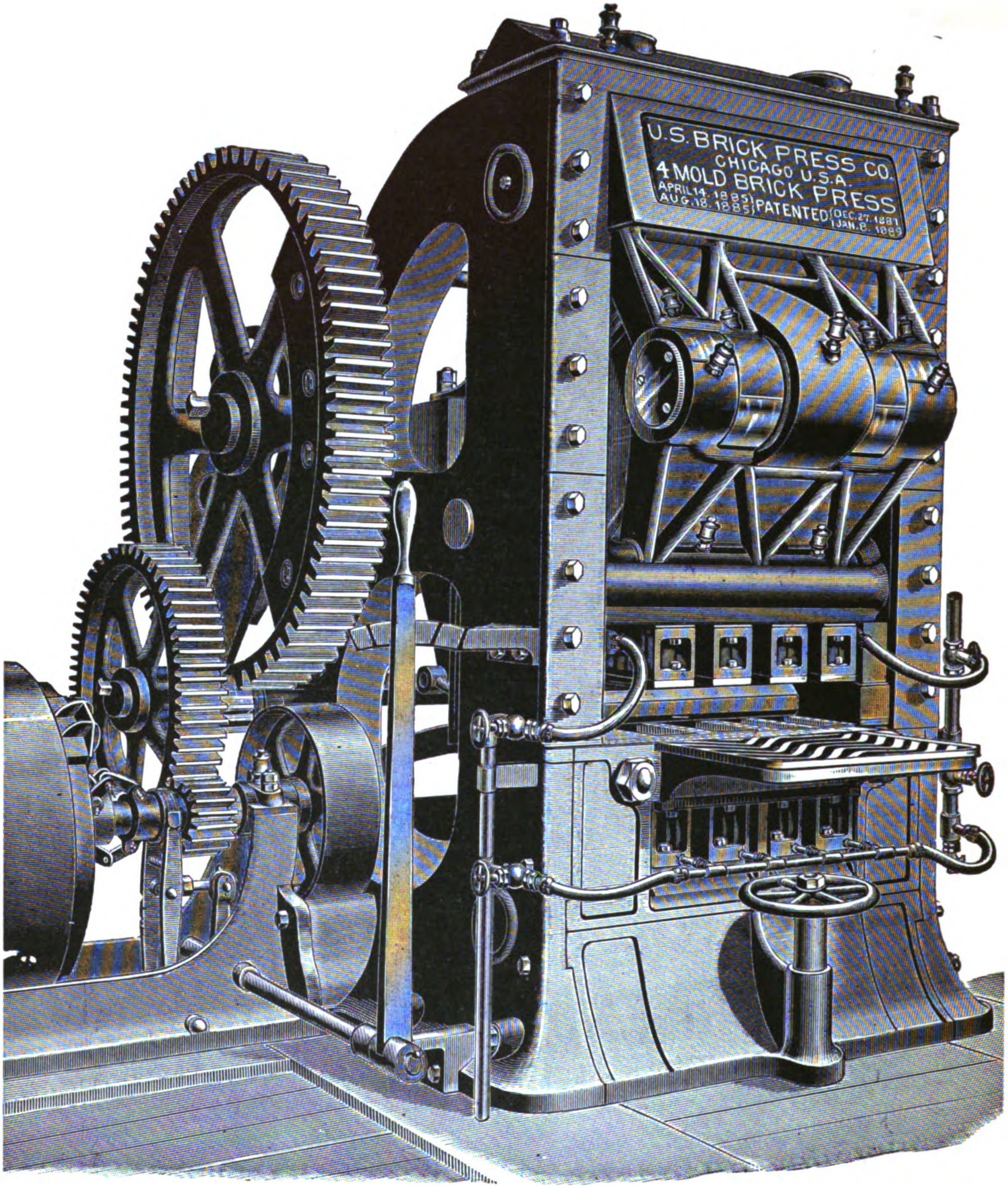

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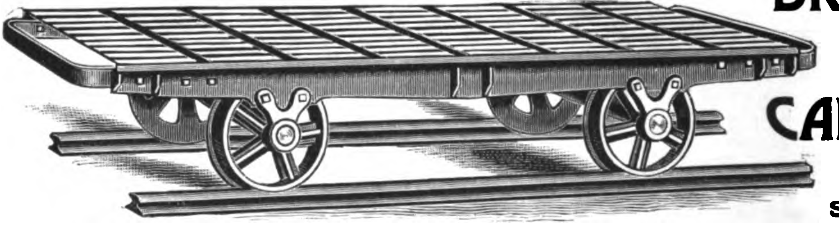

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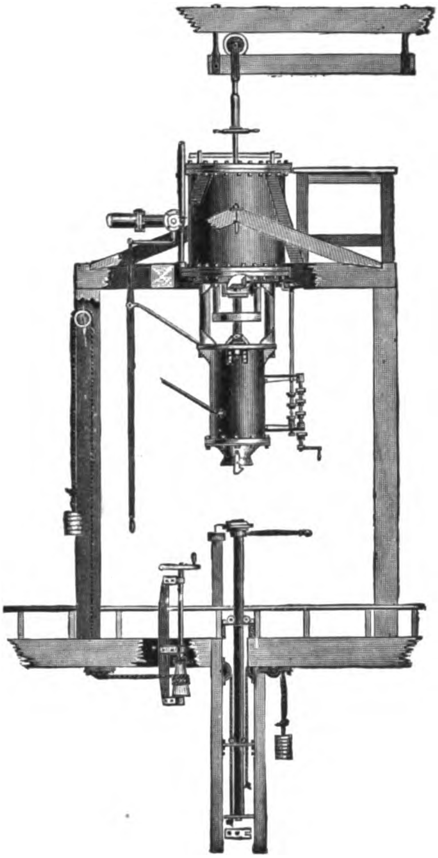

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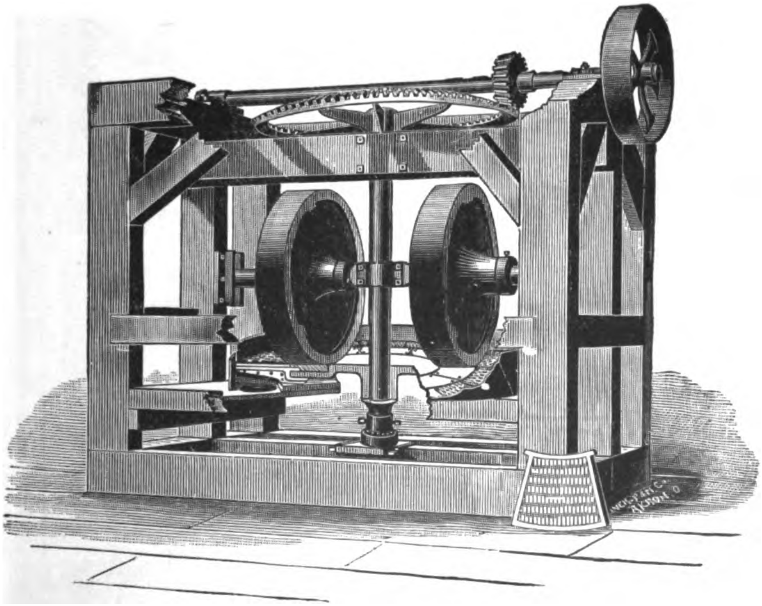

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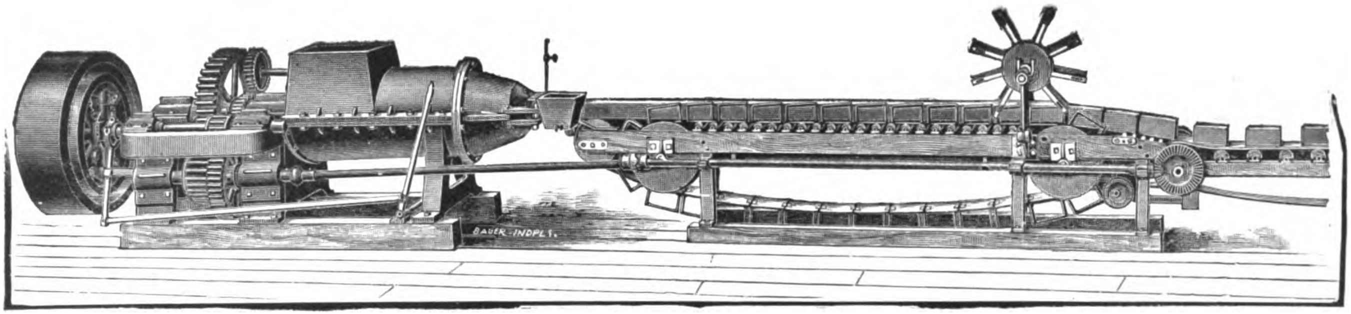
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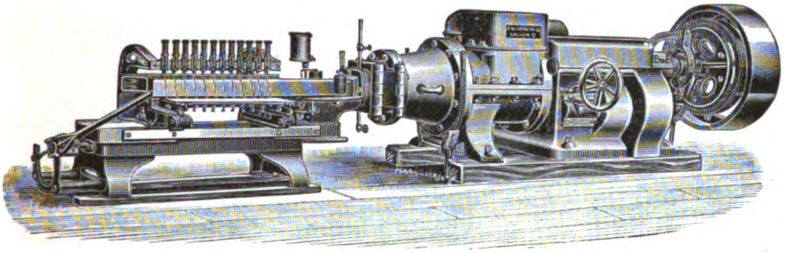

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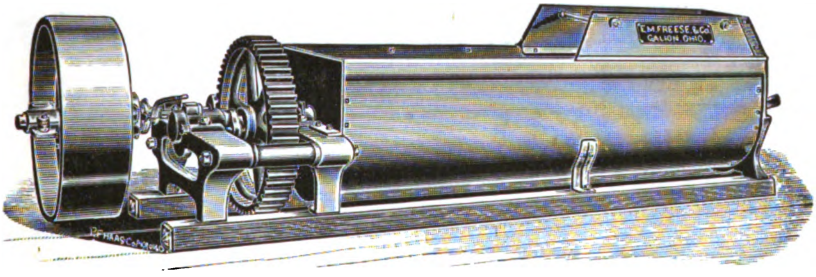
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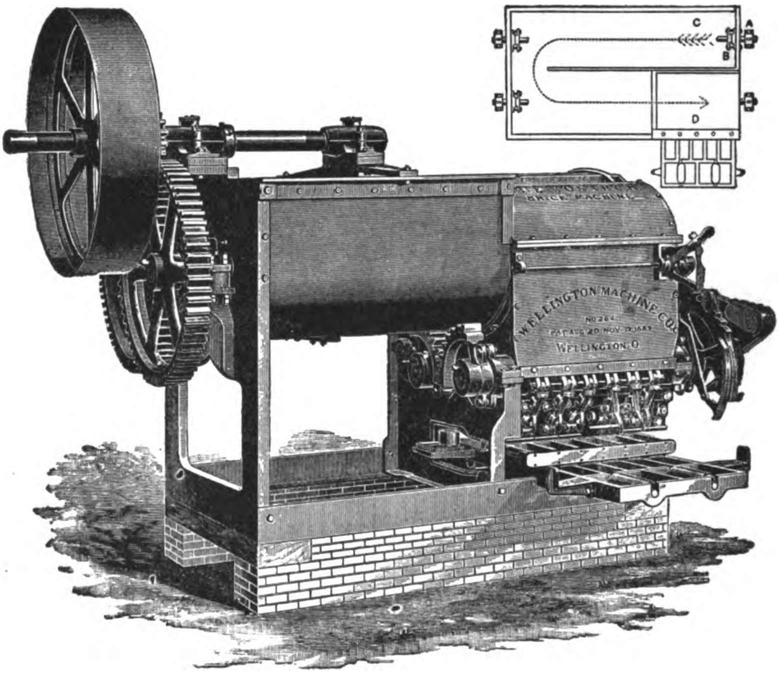

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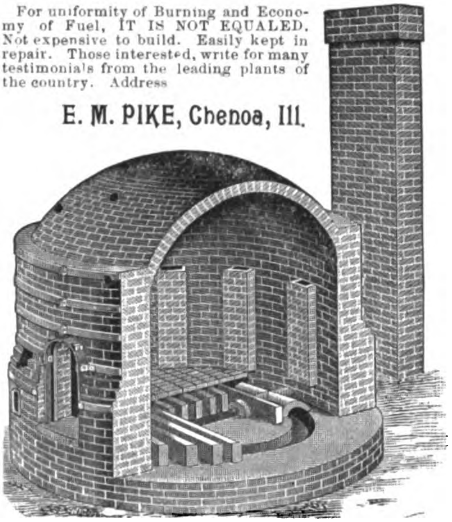

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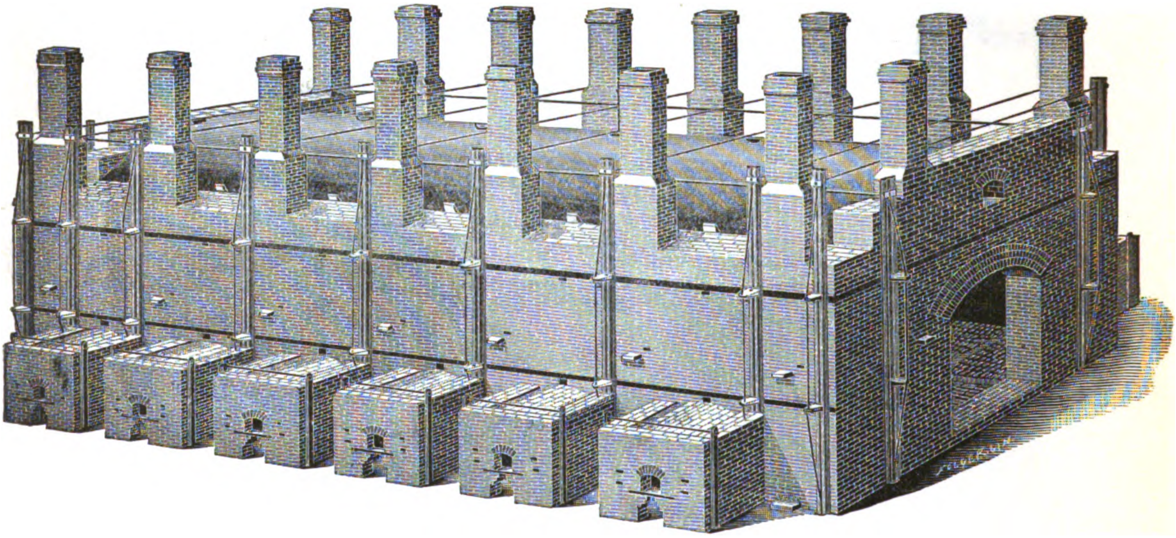

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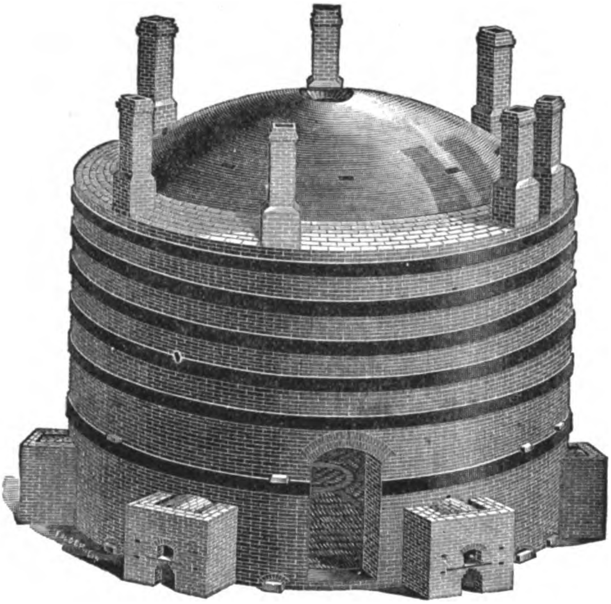

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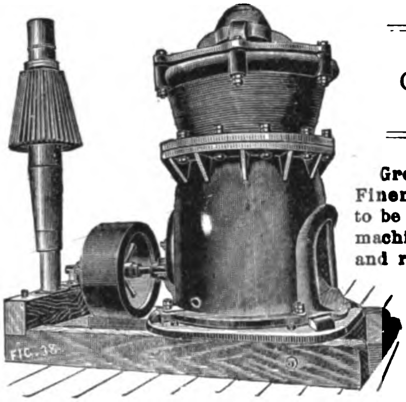

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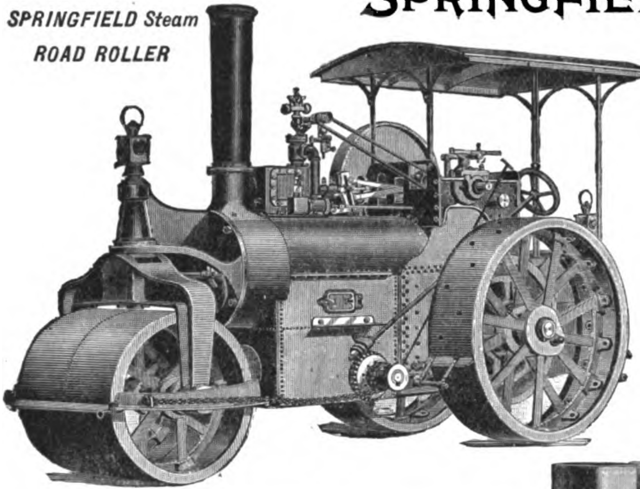

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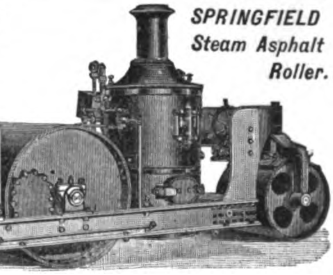

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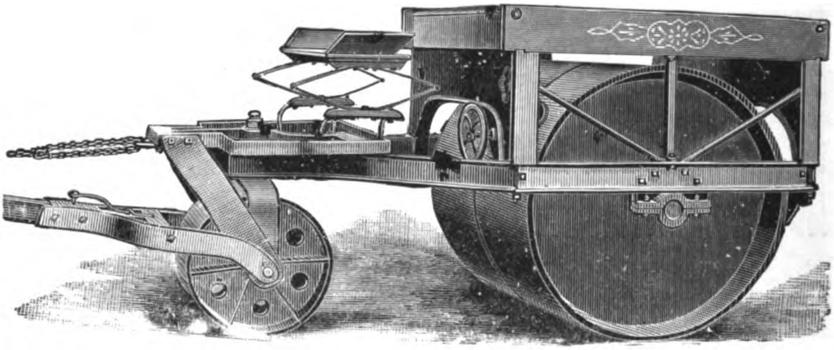

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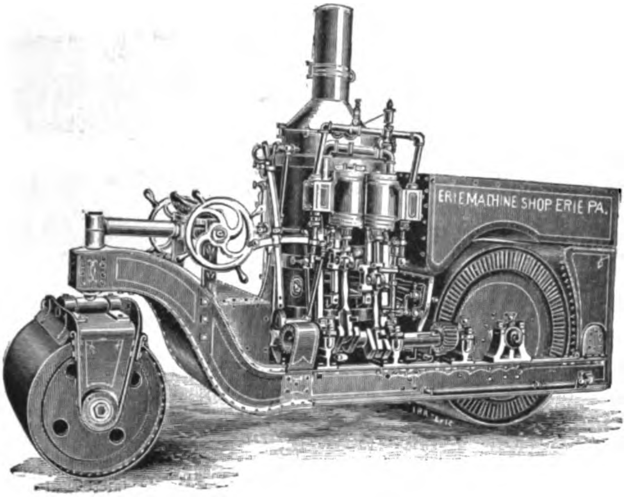
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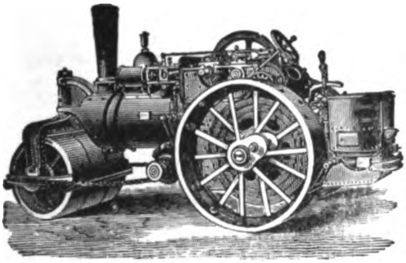

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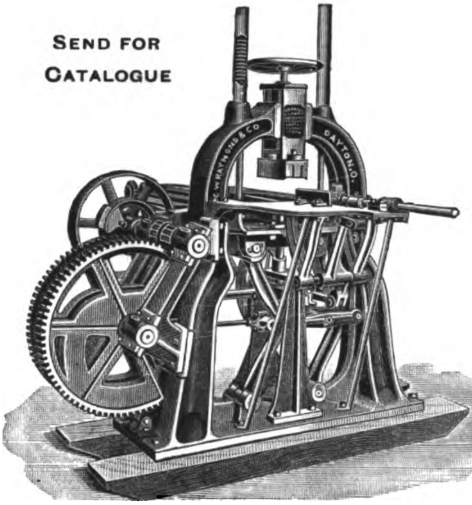
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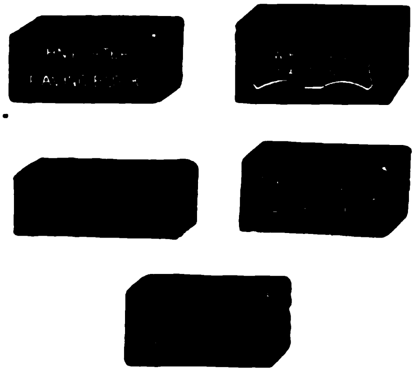

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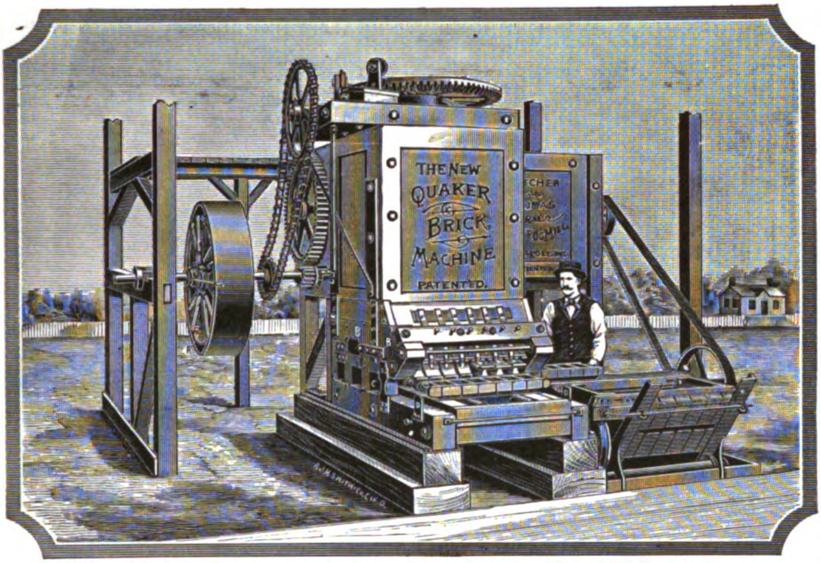

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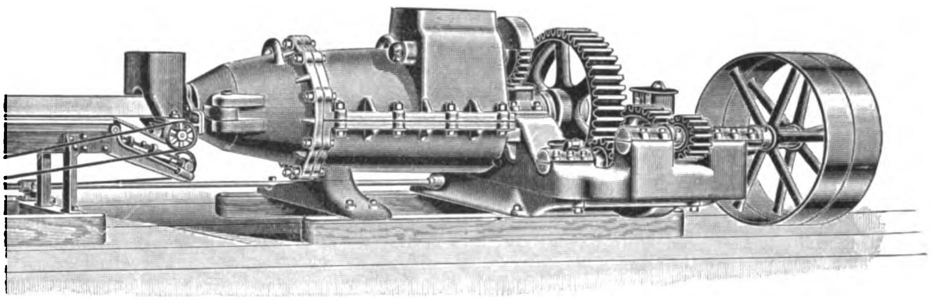

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VOLUME IV. APRIL, EIGHTEEN NINETY-THREE. NUMBER 4.

TRINIDAD ASPHALT DEPOSITS.

THE "Moruga sands," a bed of sandstones and shales, estimated at 4,000 feet thick, of the Miocene period, contain the primary deposit of bitumen in the Island of Trinidad. The southernmost range of elevated land of the island is composed of these strata, which, according to Wall & Sawkins, form an arch or anticlinal ridge, running east and west entirely across the island. The dip of the rocks along the southern coast varies from thirty to seventy degrees southward. The exposures are of soft or friable material, easily eroded by ordinary weather exposure, by which they have lost a great thickness of superficial material. Old beach lines from four to twenty feet above tide level record the occurrence of a comparatively recent elevation of the coast.

The La Brea region is underlaid by strata of this bitumen, bearing shales and sands of locally undetermined thickness and richness. According to Wall & Sawkins the unconformities of the sedimentary rocks of the island determine three periods of disturbance in the history of the island, the last of which was related to the line of hills and promontories which make its southern range—the field of its asphalt deposits. The principal deposits of asphalt at the lake and in its vicinity are surrounded by strata, which have been much disturbed, thereby establishing changed conditions which admitted an increased rock and water pressure, while a fracture of the strata afforded a ready outlet toward the surface for the thickening bitumen.

The materials of which the strata making this southern range were built are quartzose and calcareous micaceous sands, micaceous shales and clays, detrius of pre-existing sedimentary rocks, mostly of cretaceous age. The bituminous strata are of Miocene age, as are those of California, and in part, if not wholly, those bordering upon the Gulf of Mexico, from Louisiana to Yucatan.

Without exception, so far as the writer knows, the shales are in a condition of minute fracture, permitting the free percolation of water, and preventing any important pressure from gas confined within or below them. The lake is located at an elevation which is about 200 feet below the highest point of Mont L'Enfer, six miles distant, which may serve as a fountain-head for the underground waters. Thus it is evident that conditions exist at La Brea favorable to the flow of surface water to the freest contact with the bitumens, and thence to the surface through any available opening. Four miles from the lake in a direct line toward Mont L'Enfer is a group of flowing springs of liquid asphalt.

Under these conditions the natural history of the bitumen is simple and evident. It is a reasonable assumption that its hydrocarbon elements have existed as petroleum in the strata from which the asphalt flows, and further that the most active agency for its polymeric condensation has been the oxygen of the atmosphere, which, as stated by Prof. S. F. Peckham, is carried by percolating surface water down into the earth, into contact with the petroleum. Peckham also shows that an immediate effect of this contact is a release through a process of double decomposition of carbonic acid gas and carbureted hydrogen gas, and a condensation of the nascent molecules of hydro-carbon remaining in the bitumen. Probably the hydrocarbon was of animal origin, and has beem subjected to only moderate temperatures at any period of its history. A consequential effect is the flow of the bitumen toward the surface, due to the expansive pressure of the gases, to rock pressure and to water pressure. The deep-lying oils would rise on the water confined in the lower strata, and find an outlet through the over-lying rocks.

The writer believes that when sulphur is present it also decomposes some of the hydrocarbons, producing sulphureted hydrogen gas, which assists the other causes of pressure and upward flow of the bitumen. These influences have operated for a long time, and the transformation has been a progressive one.

The abundance of asphalt in the Trinidad deposit is what produces the strongest impression upon an observer. A single bed or deposit of 110 acres, the so-called lake, and outlying deposits of possibly 1,500 acres, irregularly disposed as to elevation and connection, both with the lake and with themselves contain possibly two or three million tons of asphalt when refined. All the asphalt, there, commercially available, is in these secondary deposits to which it has been transferred from its primary deposit by ordinary natural causes, as explained above.

The conditions under which subterranean concentration of fluid hydrocarbons are brought about are fully discussed by Prof. Orton, in his geological report of Ohio, for 1890, and his conclusions are believed to be applicable to the Island of Trinidad. Conditions known to exist there admit of the application of Prof. Peckham's theory of the agencies by which the deep-lying oils have been brought to the surface, and co-incidentally condensed into maltha and asphalt. All this is entirely in line of Dr. Wurtz' conclusion, as to polymeric condensation of rock oil into asphalt, who says: "Asphalts and asphaltoids are mainly produced from petroleums, by polymerization of certain constituents of such oils under the influence of the air, or of the sun's rays, or of both, together with the influence of acid, saline or other polymerizing agents incidentally present." In this connection, Dr. Wurtz calls attention to the "ample evidence of spontaneous polymerism of many native carbo-hydrogen liquids, by mere lapse of time, without the influence of other agency than that of temperature."

For several years the writer has held the opinion that the origin of the basin containing the lake proper, as well as the valley of its drainage, are to be explained without reference to phenomenal occurrences of any kind whatever. He believes that these depressions were formed by sub-aerial erosions, as have been most valleys of drainage everywhere. The refilling of such valleys of drainage has been of frequent occurrence generally, and is now taking place on a vast scale in many parts of our own country. Under common conditions, a valley of drainage is eroded in depth with much greater rapidity during the period of its earlier history, and there is thus provided a steep descent for all lateral streams, which obtain in this manner the power to excavate with increased rapidity their separate valleys. As these lateral branches increase, the area of erosion is increased and the quantity of eroded material is enlarged too rapidly for the main stream to remove it, and its valley begins to refill. This summary of the course of events may be stated as a brief history of nearly all the rivers of our country, with all their branches and minor subdivisions up to the little rivulets near their fountain-heads.

The valley of La Brea was undoubtedly formed by the action of the waters flowing through it to the sea. The rocks are very friable and incoherent, and weathered readily, thus forming in this case, as it generally does, a wide dish-shaped depression at the summit where the water gathered to form the head of the stream. Its deepening channel cut down into some bitumen-bearing strata, or opened vents from the same, probably doing both, so as to receive into its depression the outflow of malthas from below. Thus was brought about a more rapid action upon the imbedded hydrocarbons, a larger production of gas, and a more voluminous discharge of maltha into the valley. The maltha flowed down the slope, a distance depending upon the temperature, and the rapidity with which it hardened from exposure. Soil washed from the sides of the valley formed beds in its more level reaches, and at times these were overflowed by subsequent outflows of malthas. So by irregularly acting natural causes, the valley became filled; and the bitumen at the upper part of the valley became impounded, and constitutes what is called the Pitch Lake.

Visitors to the Pitch Lake sometimes advance theories explaining the origin of the bitumen which are inconsistent with the conditions of attending occurrences at that place, and of similar phenomena in other places throughout the world. The greatest service of Mr. Richardson's sixth annual report, in this connection, is his reprinting of Mr. Manross's description of the lake in 1854.

The writer is yet to hear of any phenomena in the vicinity of the Pitch Lake that may reasonably be referred to heat agencies, such as attend even the mildest forms of volcanic action. The basin of the lake and the valley of its drainage down to the sea are, he believes, parts simply of an eroded valley, similar to hundreds of others at places of bituminous outflow in California and elsewhere. The greater rainfall in Trinidad, compared with that of the region of the Coast Range, in California, accounts for the greater outflow of bitumen in the vicinity of the former. In California there is a visible increase of the flow of maltha from its springs, in the rainy season.

The quantity of refined asphalt to be obtained from the crude materials exposed in and near the lake may be estimated at a maximum as follows: Thirty feet of depth at the center of the lake, yielding 2,000,000 tons; in the land deposits possibly as much more, making in all 4,000,000 tons. Actually the gross amount may not exceed one-half of this.

The comparative importance of the deposit is due to its accessibility. There are two or three similar deposits in the Argentine Republic, located beyond the limit of economical transportation.

As to the primary source of such a vast quantity of asphalt, we repeat that it undoubtedly lies in the immediate vicinity, deeply buried in the earth. The possible capacity of asphalt or petroleum-bearing strata to yield the material is not often fully considered; hence the following calculations and statement may prove of interest:

Beds of oil-bearing rock covering hundreds, even thousands, of miles of area, of varying thickness, sometimes amounting to hundreds of feet, may contain ten, fifteen or twenty per cent. of bitumen. One square mile of such rock has, for each foot in depth, 27,878,000 cubic feet contents. Ten per cent. of this, as a theoretical yield, gives 2,787,800 cubic feet of bitumen, or over 80,000 tons; for fifty feet of thickness, 4,000,000 tons. One may vary the estimate by changing the area, the thickness of the strata and percentage of yield, and so find an estimate which will appear reasonable to him.

There is abundant specific information to the effect that there has been in the past a large active overflow of asphalt from the lake, which was visible in 1854, being at the surface of the ground. A description of this phenomena as witnessed at the time is given in the account of the lake published by Mr. Manross, *Am. Jour. Sci.*, 1855. If active overflow has been in operation in recent times, it has been beneath the mass constituting the present surface of the deposit. This is stated with admission that there is still probably an exceedingly slow movement of the hardened surface deposit, one too slow to be properly designated as an effective one. The thin-ness of the soil covering the asphalt near the lake is possibly an indication of this. With rapid movement of the asphalt, the earth which has been washed over it by rain, and also in part resulting from the destruction of the asphalt by fires and atmospheric decomposition, would have been carried away, leaving a bare exposure of the asphalt. As the asphalt below the surface is softer, it necessarily is more subject than the surface material to a slow viscous movement, due to gravity and pressure. If there are tar springs beneath the land asphalt, a matter yet undetermined, they will materially contribute the same result. It is difficult to understand how a viscous solid subject to the heat of the tropics can possibly lie still, if resting upon a bed of tar and on sloping ground. Hence it is legitimate to assume that if the tar or a soft asphalt exists beneath the surface land asphalt, the latter has some flowing or sliding movement down the hill; if there is no underlying tar springs, then all the asphalt has been necessarily derived from the lake. So, view it as one may, the conclusion is forced that substantially the land and the lake asphalt are from the same subterranean and fountain source.

Taking the position in argument that the asphalts of both deposits are lake asphalts, the one question to be considered is whether the older, the land asphalt, is less suited for making pavement cement than is that now taken from the lake. It seems evident that the hardened crust of the lake, found near its borders and around its many islands, is substantially like many of the surface land asphalts. That found near the center of the lake is softer than the others, and the question involves a comparison of asphalt from the softened mass near the center of the lake, and the best land asphalt, dug from beneath the hard surface deposits of the land. The comparison being of like grades from the two deposits, and of asphalt in shipping quantities, not hand samples.

It is believed to be indisputable that in each and all of these respects there is absolutely no difference between land and lake asphalts. The asphalt may be considered probably as an alloy of differing hydrocarbons; certainly that is what the paving cement may be called. Purely and simply, it is an alloy of the asphalt and the residuum, or other tempering material; and, as you restore any lessened element of an alloy, as brass, spelter, etc., so in an asphalt paving cement, if it becomes too hard from loss or change of oil, you restore the softness of it by adding or replacing the lost ingredient.

All discussion of the comparative merits of crude, and even of refined asphalt, used in paving, is not very important. These materials are not used directly in paving. They are always subjected to treatment in preparing cements, and the qualities of crude, and also of refined asphalts are much changed thereby. Pavements are made with asphalt cements, and not asphalt either crude or refined. The real question is, which is the best cement? *D. Torrey.*

Dolphus Torrey was born November 30, 1833, in Sherburn New York. Both his paternal and maternal lineage is traced back to the earliest settlers of New England. He had the advantages of country schools only and began business life at fifteen years of age by learning the trade of molder in an iron foundry. He went to Davenport, Iowa, in 1854, and was soon after employed as passenger agent by the Pennsylvania railroad. In 1861, he enlisted in the Cincinnati Rover Guards, for the three months service. Afterwards he raised a company at Davenport, Iowa, Company D, Twentieth Iowa Infantry. After the war he accepted a position in the general office of the Pennsylvania Railroad Company, at Philadelphia. Subsequently he had charge of the sleeping-car service of that and associated roads, until appointed Chief of Transportation United States Centennial Commission, 1876. In 1887, he entered the service of the Warren-Scharf Asphalt Paving Company, since which time he has been interested in asphalt paving, being now with the Trinidad Asphalt Refining Company. His life has been that of a student, with strong inclinations toward the physical and natural sciences, of which geology has been most favored by him.

Two years of his time has been given to personal investigation of the asphalt deposits of this country and Mexico, and laboratory investigations of samples of asphalt gathered by himself. He made one or more trips to Utah, California, and the Huasteca region of Mexico, thereby gaining the information which forms the basis of his present opinions concerning the origin, accumulation, and properties of asphalts.

BURNED CLAY FOR ROADWAYS.

I consider burned clay, when properly prepared, very good material for residence streets, providing all streets leading to it are improved. Mud carried from an unimproved street will soon pick the clay up and carry it off. It was first used in Kokomo at the intersection of two well traveled streets, covering only about forty feet square. The clay was of good quality, burned hard. In the center it stood all right, but near the foot crossings, where the streets leading to it were muddy part of the time, muddy wheels would pick up some of the material near the crossings and carry it off. It was not long until there was quite a basin near the crossings. The street that was to be constructed of burned clay was never received, it being a very poor piece of work. The clay was not good, having in it quicksand, gravel, white and yellow clay, beside the top soil, and then not burned hard enough. The roller used was a light one, only weighing five tons. It should not have been less than fifteen tons. The surface of this street in wet weather becomes very soft, and wheels cut in from one to three inches. During dry seasons it does very well, but a dry weather street is not what we want.

I can not give proportions, but burned clay is made by first laying a long row of kindling wood on the ground, with enough slack coal added to make a good fire. This is then covered with good, pulverized brick clay to a depth of a few inches on the sides, care being taken to leave a draft for the fire; it is then ready to light. The fire should be under good headway before adding more clay; then put on in alternate layers of clay and slack coal. After the top is covered it should be penetrated every few feet with a sharp-pointed crow-bar, or the fires will smother out. This should be done as each layer is added. When it is of sufficent height, say about five or six feet (to insure good burning), it should be watched all the time to keep the holes open. After it is burned out it is ready for use.

Burned clay, like all other material for street building, should have a good substructure. That being faulty, so will the superstructure be.

Care should be taken to provide good drainage before material goes on by putting in a red tile on either side, about thirty inches deep. The sub-grade should be rolled with a fifteen or eighteen-ton roller before putting on the burned clay, which should be put on in four-inch layers, each layer to be thoroughly rolled with the same roller used on the sub-grade. Three such layers are sufficient to make a good roadway. Water will not stand on it, nor will it support vegetation. To a certain extent it is springy, almost noiseless and very easy on a horse.

I consider it, when well made, desirable for residence streets or parks, but not best for heavy traffic. It can be constructed for about $1.20 per square yard, exclusive of grading and curb.

A. W. Smith.

A. W. Smith, city civil engineer of Kokomo, Ind., was born in Miami county, Ind., June 19th, 1858, where he was raised and educated; afterward teaching school awhile; always with a decided taste for mathematics, but none for teaching. He abandoned that in two years and locating at Kokomo, Ind., in 1883, he soon became assistant city civil engineer, which position he held until June 3d, 1889, at which time he was elected city civil engineer. Since then he has been very busy. All his practical work has been done there.

CEMENT SIDEWALKS AND HOW THEY SHOULD BE MADE.

In the last five years the city fathers of many towns of the central part of Illinois have adopted an ordinance wherein all pavements for sidewalks, in certain parts of the city, "are to be cement." This is a most worthy ordinance. Cement walks are more inviting to the stranger, and more appreciated by the owner, than any other kind. They are always clean, easy to walk on, more pleasing to the eye, and give a beauty of finish to streets and boulevards which seem to blend with the property and all surroundings. Cement walks, when made properly, are even more durable than inferior qualities of lime and sandstone. All contractors should guarantee them for ten years. The nature of these walks is that the longer they lie the harder they get, while natural stone will eventually shell off, show water holes, become rough and decay to a certain extent. The question of sidewalks is a very important one in the permanent improvement of cities, and it is to be hoped that the merits of cement for sidewalks will be investigated more.

Cement walks are more successfully made from crushed granite and Portland cement, which is called "granitoid," and is classed as first-class work. The success of granitoid in public improvements in the city of St. Louis, Mo., has been remarkable. These walks are to be seen in all the principal streets of the city, and miles of such walks now flank the public parks. In the last two years the alley drive-ways, in the heart of the city, have been paved with granitoid, and the heaviest loads pass over it constantly without injury to the pavement.

Portland cement and clean gravel and sharp sand, mixed up in a plastic condition, spread out, troweled and finished, is considered just as good a walk as the granitoid work, excepting its richness of color. It is not, of course, as hard a substance as the hard granite would produce, yet in small towns, or in large cities where the travel is not too great, it answers the purpose just as well as the first grade, and, being made with such cheap material, is brought within reach of nearly all property owners, as the cost is at least 40 per cent. below the granitoid work.

In making a cement walk you must first have a foundation of cinders, gravel or sand of not less than eight or ten inches deep, which must be rammed and tamped and thoroughly wet, so that they will pack and the foundation will be solid; second, the contractor should lay out his work so that the inside line of his walk will be the highest, which will carry the water off quickly; third, keep the walk as high as possible above the level of the ground. If the contractor is making his walk four inches thick, then the inside of the walk should be four inches above the level of the ground on the inside line. By keeping the surface of the walks three or four inches above grade line, it always keeps them cleaner and drier and does not retain dampness as much as if the surface was about even with the grade line.

The specifications for cement walks vary considerably. In granitoid, the grouting is four inches thick, composed of three parts of coarse crushed granite and one part of Portland cement, dry, mixed over at least three times before wetting, and immediately spread out; while in the second grade work six parts of clean gravel to one part of Portland cement is sufficient. The blocking off of the work is important, and is the secret of making a successful walk. It must be made so that the frost will escape from under it, or it is bound to heave and crack. This is done by making a joint in the grouting, and another joint in the topping or wearing part, exactly in the same place as the joint was made in the grouting. These joints must not be made too far apart. The blocks should be as near square as possible. In a ten-foot walk, then, the blocking should be made five feet square. In a twelve-foot walk they should be made four feet square. These joints are a protection from the frost, as it will escape from the joints and not crack the walk.

Only Portland cement can be used for sidewalk purposes, and there is only one way to use it successfully—that is to float it in the grouting, so that the water will come to the surface, and immediately pour on the topping and work it on the same principle, bringing the water to the surface of the walk. It adheres to the other material, and will make a solid stone.

There is no need of chemicals in making cement walks, as pure granite, gravel, sand and Portland cement are the cleanest of materials and are not subject to decay. *E. L. Martin.*

E. L. Martin was born in Decatur, Ill., in 1860. He started a coal yard at the age of twenty, and a few years after he added to his business contracting in cement sidewalks. He is the leading contractor in Central Illinois for cement walks, and has done much in the way of beautifying cities. He was the first to introduce cement walks in the leading cities in Central and Western Illinois, having laid the walks around state and public buildings in the cities of Jacksonville, Champaign, Springfield, Quincy, Peoria, Bloomington and Litchfield, Ill., Hannibal, Mo., and Paducah, Ky. In many other towns he has done work. He has a branch of his paving business in Springfield, Ill., and is also interested with William Shuler, of Ottawa, Ill., in the paving business. He is also president of the Macon County Coal Company.

WOOD PAVEMENTS IN PARIS.

It is a surprise to an observer to see the amount of wood pavement being put down in Paris. A pavement which is literally worn out under four years' traffic on Boulevard des Capucines has recently been replaced by another. Demands are made in other sections of Paris for wood pavement. Why? is asked. One reason is that it is relatively less noisy; and, again, they have not had the extended experience with it that has been common to some other cities, where it is now received with less favor. People who live on the boulevards are disturbed by the noise of the other pavements. The wood pavement, while not greatly less noisy, is, in a measure, less objectionable, and for that reason is received with more favor. In Paris these wood pavements are splendidly cared for. Within three months from the time they are put down, inspectors may be seen passing over them, taking out the bad blocks and putting in old good ones. This operation is continued until the pavement is entirely worn out. In truth, there is never a time in its history when it shows itself to be in a state of decay or neglect. It is always a relatively smooth pavement. It ceases to be used when the blocks are worn down. Some of the blocks recently removed from the boulevard named were worn down within two and a half inches of the cement base on which they were laid. This was to be noticed at the street crossings where there was not only traffic of the boulevard, but that of the street which crossed it.

In Berlin the block pavement seems to be in a greater state of neglect. The authorities there do not look on them with favor.

Louis H. Gibson.

MAINTENANCE OF ROADS IN FRANCE.

IV.

REPAIRS.

THERE may be two classes of repairs: one when a road has been neglected or under the care of an inexperienced man for a short while, and the other when a road has been totally abandoned for a number of years.

In the first case the damage is caused because the mud has not been cleaned or because the spreading of new stones has not been done intelligently, or because those newly spread have been neglected.

When a muddy road is cut up by ruts, the first work to do is to clean it, and often it is found that the ruts were only apparent, the ridges on each side being nothing but mud and a few loose stones, and only a slight depression exists in the road-bed proper that will often disappear under the wheels when they will cease following the same track. If, however, the depressions were deep enough to be too inviting for the wagons to follow them, it would then be necessary to fill them with stone, not above the level of the surface, but rather below, in order to prevent the wagons from cutting new tracks right alongside of the filled ones. Should wagons attempt to keep too close they would fall back in them every once and a while, and by that means keep the surface level.

If ruts were filled with stones before the mud is cleaned out, it would be a waste of material and of time, because new ruts would be necessarily formed parallel with the first ones, and the road be just as bad after as before.

Of course if a muddy road shows ruts when cleaned, it will also show many depressions here and there that will need to be attended to, as I explained before; and, moreover, when a road has been so neglected through carelessness or lack of judgment of the "cantonnier," it will pay the engineer to send a good man in his place, because that part of the road needs extra precautions that the man who has allowed it to come to that point will not be able to take.

There are other causes that will bring a road out of repair. For instance, a "cantonnier" seeing one side of the road lower than the other will cover it with new material. Then the wagon will naturally make for the other side at the same place, and soon cut ruts on the best side and never attempt to run on the new stones as long as the other side is practicable at all. If such work had been done the only remedy would be to take up those stones and raise the low place by the patch process. The same is true if the whole width of the road was covered with new material on any length. Wagons soon make a track and never leave it. So unless the road is provided with a convenient roller extensive filling can be done in no case whatever.

But when the road has been entirely neglected for a number of years and it becomes necessary to bring it to a good state of repair, the first method that presents itself is to pick up all the stone, screen it clean of dirt, break it to regular size, level the road-bed like for a new road and replace the macadam by adding enough new material to give it the proper thickness.

This simple process will certainly make a good road out of an old worn out one at as little cost as may be expected. It has a grave inconvenience for roads with large traffic; in fact, the picking up of stones, the leveling of the road-bed and the spreading of the material over it will occupy a comparatively long period of time, unless money enough has been appropriated to do the whole in one season. In most places but one track will be left open to traffic and if the weather should be damp and rainy, people would soon regret their old rough road.

To avoid this inconvenience another method is used. First soundings are made to ascertain the thickness of the macadam and if it is not too thin the top is cleaned out of all loose stuff, stone or dirt, then the bumps are picked down and the holes are filled and in a short while the surface may be made smooth. Though the whole macadam may be thinner than it ought to be, it is only raised by a continuous patch work without materially obstructing the traffic. If the bottom had been made of larger stones, as in the Telford system, and their tops would protrude above the surface, it would be advisable not to disturb them, but simply break off the protruding points. This method is slow, but general and progressive. With, of course, an adequate increase of labor, the road keeps growing better from the very start without, like in the first mentioned method, passing through a worse state to become better.

It is plain, however, that if any important changes were needed in the grade of the road to be repaired, the first method would necessarily have to be employed in order to raise or lower the road-bed before spreading the new material.

This covers about all cases of maintaining a good macadamized road, yet I think it would not be out of place to say a few words about their thickness. In France, where roads are continually taken care of, it is admitted that from eight to nine inches thick of well made macadam is able to bear the heaviest traffic, that the road does not need to be crowned too much on the center, one-half a foot raise on a road twenty-five feet wide being ample enough. Water does not remain on a level, smooth surface and the wagons are not so inclined to exclusively keep the center and the width of the tires are by law regulated in proportion with the weight of the load hauled.

Arthur Lagron.

ARTHUR LAGRON, C. E.
See biographical sketch in January number, 1893, page 17.

THE EVOLUTION OF THE BRICK MACHINE.

My earliest recollection of a brick-yard was the abandoned one in my father's meadow, a *much burnt monument* in the shape of "stuck arches," the "stick" extending high above the "running courses."

All traces of a brick-yard had vanished except this monument to the skill of the burner and the clay pits, which made skating parks in winter and most admirable fishing ground for "minnows" and "sun-fish" in summer. I remember that these same fish were wonderfully skilled in "taking the worm" from "the bent pin" and avoiding being "landed" by the beautiful white cotton string secured from the wrappings of the last purchase of sugar made by my mother. If my recollection be correct, some of the "sugar" went with the string, but not to the fish.

The next investigation into the art of brickmaking was to the yard on a neighboring farm, that afterwards became the country-seat of our much-loved poet, Bayard Taylor, and where he built the beautiful "Cedar Croft" in after years.

At this enchanted ground the young investigator found one shed, probably one hundred feet in length, of low construction, made of rough round forked sticks set in the ground, with the crotch up, in which laid sapling poles, supporting boards of various thickness, widths and lengths, some sagging to a graceful curve and others endeavoring, by their straightness, to keep up the dignity of the structure, as a drying shed.

In the clay pit I found what proved to be a human being with arms bared above the elbows, feet and legs without covering below the thighs, bespattered with mud from his eyes down, the coating increasing in thickness as it reached his heels.

This "artisan" was tramping in an oven-shaped mound of soft mud up to his knees, and with all the diligence attributed to the beaver.

Out in the glaring heat of a mid-day summer's sun stood a man at a low table with a square (?) box made of wood, which he alternately dipped into water, then into sand, and finally filled it with a portion of the tramped clay from his partner's mound—the brick was thus finally "molded" and borne of by the diminutive "apprentice" and dumped in a misshapen mass upon the leveled ground. The "molder" had eyes, but they were only visible by their brightness through the two upper cracks in the dried coating of clay and sand covering his face.

In after years, when childhood had given way to boyhood, in teens, an older brother, who was casting about for a business (having grown tired of the "whirr" of the spinning-jenny which he operated in our father's factory), visited a neighboring city to investigate and witness the trial of a wonderful invention for the purpose of making brick by the "dry clay process."

This machine had the usual number of cog-wheels, cams, toggles, levers, abrupt movements of large masses, etc., all to go through their evolutions for each brick produced.

A bov that had grown up in a woolen mill, and ran a saw-mill, needed no long investigation nor a second visit to determine the impracticability of such devices under the abrading process and influence of the clay.

Returning home disabused of the idea that he had found the long sought for desideratum, he said to me, "Cy., I wish you would make me a brick machine."

"Cy." commenced.

After studying the then prevailing methods of making brick in vogue then in the vicinity of Philadelphia and carefully noting the various processes, and visiting numerous locations where other processes had been tried, a systematic course of experiments was entered into to determine a practical, if not the best, process by which brick could be produced by machinery.

It was soon apparent that a "machine" which molded brick only was of little or no practical value, because the molding alone was but a small part of the labor and expense attending the production of brick. There was the preparation of the clay, by "winter digging," the mixing of the various qualities, the tempering, "off-bearing," "drying," "edging-up," and finally the taking in and "hacking under cover," if the storms permitted them to reach a proper condition for the latter processes; if not, then they were shoveled back into the pit to be "ground over," and all the subsequent operations repeated.

Next the "dry clay process" was examined into, with the hope that it offered a more encouraging outlook for the youthful mechanic and inventor.

Some samples of fine, tenacious clay were procured, dried and pulverized (a process costing far more than to make the wet material into brick at once). So dry and fine was this clay that by throwing a handful of it into the air it floated off and you couldn't tell where it fell.

This material, thus prepared, was put into a round mold of great strength, turned out true inside in a lathe and furnished with a plunger, snugly fitted. In turning out the mold the lathemen withdrew the turning tool without easing up the cut, thus producing a fine groove throughout the length of the mold.

This mold, being filled with the finely pulverized and dry clay, was put under a hydraulic press of great power and submitted to a pressure of 600 tons, or over 120,000 pounds to the square inch.

What was the result?

Notwithstanding this clay had been in a steam-heated room for over three months this enormous pressure caused the water to flow from it all around the plunger, and at the fine groove (made by the withdrawal of the turning tool) the clay issued in a stream as fine as a human hair, curling in all directions like a thing of life.

This brick was burned and upon examination after burning showed each granule of clay in its primitive shape with fine fissures between each, clearly demonstrating the want of thorough incorporation and adhesion of the various particles.

Upon submerging this round brick in water it absorbed 5.55 per cent. of its weight, notwithstanding it was "hard burnt" almost to vitrification.

This demonstrates four things:

First. To dry clay perfectly is impracticable, if not impossible.

Second. That no reasonable amount of pressure alone will cause the various particles of ordinary clay to adhere and form one solid, homogeneous mass.

Third. That argillaceous and sandy material so put together and burned was a great absorber of moisture.

Fourth. That a brick so made, burned and soaked would not stand "freezing and thawing," but would crumble to dust, and each granule of sand and each particle of clay remain in its primitive disconnected condition and could be distinguished in the blackened mass.

Discouraged by the investigations into the two proposed extreme plans for a process upon which to construct a machine, an intermediate process was conceived of, and experimented upon, with gratifying results.

By working the clay as nature furnished it—with the natural moisture in it—all time expense of drying was avoided.

By mixing and tempering in a stiff consistency the granular part of the material was thereby incorporated with that of the plastic, and a thoroughly homogeneous compound produced. When forced to shape, "molded," in this stiff condition, the bricks could be at once handled, wheeled to sheds, and "hacked up" out of the weather, thus avoiding the expense of floors, "edging-up" and "taking-in." Samples made by this process stood all the tests of strength, absorption, frost, etc., and it was determined to proceed to construct a working model upon this general principle, that is, which is now known as the stiff tempered clay process.

But the young mechanic had much to learn yet. The power required to temper and mold "stiff clay" was not in the books.

Experiments had to be made to get the necessary data from which to construct even a working model upon this principle.

The power required to temper and mold this stiff clay was so far beyond that which any machinery then in existence for working clay would stand, that the whole field had to be explored from the beginning to the end, and notwithstanding all this the first model machine was continually breaking down, or sticking fast, or refusing to turn.

When it broke down the parts breaking were strengthened and improved in design, and when it "stuck fast" the reason was examined into and finally a working model was produced which tempered its own clay, molded the same into a continuous bar one-third the thickness and breadth of that of a Philadelphia brick. This bar was severed into "brick lengths" by an automatic cut-off, a knife on a wheel, whose speed was regulated by the flow of the clay from the die, and the brick so severed off-borne on an endless apron, ready to be hacked.

The miniature brick produced by this model were burned and examined by expert brick-makers, masons and scientists. Their strength was tested and all kinds of critical examinations made, particularly the incorporation of the various materials or various particles entering into their composition. I remember one old Friend, a practical brick-maker, who scanned closely the texture, from under his broad brim, and examining closely a piece, not larger than a pea, said: "W-e-l-l! it is well tempered, but I don't understand why the 'skin' is so fine and so much richer in color than the rest of the brick."

Here was something that had escaped our notice entirely.

Upon examination of these toy bricks, under his guidance, we saw that the die surface of the brick was exceedingly fine, smooth and of a much richer cherry-red than the body of the brick.

No sand having been used in molding it could not be attributed to the superior coloring of the sand, besides it was much finer and smoother than the "skin" produced by our finest Philadelphia sand.

Farther experience taught that this result was due to the action of the machine upon the clay by moving the particles through and between each other, while under great pressure. The finer portions of the material were forced into the interstices of the larger ones, and to the surface between the coarse particles and the die, thus thoroughly cementing together the granules of sand and producing a "skin" of the finer and long portions, which "color" in burning, and thus producing that effect so much prized by the manufacturers of "red brick."

Knowing that to embark in the construction of a large machine for the manufacture of brick meant much labor, time and the expenditure of much time and money, and that it wasn't to be entered into without due consideration, an invitation was sent to my father, then well advanced in years, to come to Philadelphia and see the model machine. This he did, for he was a great lover of machinery, a born mechanic of no mean order, and had the success of his "boys" at heart.

He was taken into the room where the model was and it was set running; he looked the machine over carefully without uttering a single word. No explanation was needed by him, he reading from the machine faster than we could describe it. Then he went to one side and took a seat on a tressel, watching the machine run for more than an hour. Not a question asked; not a word uttered, but a silent examination from the beginning of the operation of feeding the crude clay into the machine until the finished brick reached the end of the off-bearing apron.

Presently he arose and said: "Well, boys (we were men grown then), I will risk all I am worth on that machine."

"The die was cast;" when he approved there was no longer hesitancy, but to the construction of a large machine at once, notwithstanding dollars were scarce, and the mutterings of the coming "unpleasantness" were heard in the distance, for this was in 1860.

This was the first completely automatic machine ever produced, performing all of these operations in one continuous operation by one completely embodied mechanism. A recent and thorough search into the 24,254 patents issued by the United States Patent Office, and those of foreign countries, for brick-making machines, fails to show any complete automatic practical machine for producing brick or tile upon this principle prior to the completion of this model machine. This machine was conceived and constructed in the latter part of 1860. Working drawings were made for a large machine (large indeed it was, a single piece weighing over 5,000 pounds), calculations were made trom the best data we had gathered from the numerous models we had broken down for the strength and power required, and the machine constructed, erected and tested in the shop.

Our shop was then in the second story of a building at Seventh and Cherry streets, and the owner was afraid it would break his building down, the complete machine weighing over ten tons.

We stalled his one hundred horse-power engine, smashed down spur wheels of enormous strength, twisted off heavy shafts, and parted bolt after bolt before we learned the properties required for the machine, and the power required to temper and mold stiff clay.

Finally the machine worked—producing thirty brick per minute.

An exhibition was given to which our numerous friends and the brick-makers of Philadelphia were invited.

Our friends were delighted, but how about the other class, from whose pockets we hoped to extract the thousands of dollars we had expended in this enterprise.

Many objections were urged by the practical brick-maker, the "hand men" as they all were at that time. There is "no sand on them," "their ends are rough," "they are of unequal lengths," "the clay is stratified," "the clay is laminated," etc., and according to the general opinion the machine was "no good."

Discouraged by these opinions, but not disheartened, the objections were carefully studied and all were overcome except the "rough ends" and the "lamination" of the clay.

The cut-off was so improved as to meet practically the objection of varying length. A sanding device was invented, whereby a coating of sand was thrown over the freshly molded and moist brick; but all efforts to eliminate the "stratification" in the clay were unsuccessful except in degree. These changes and experiments consumed another year. The excitement of a civil war was upon us, labor was becoming scarce and rapidly increasing in cost. The brick consumer became less fastidious and we concluded that then was the time to make an actual test, in the yard, and the only way to demonstrate the practicability or impracticability of manufacturing brick by this then novel process.

Knowing full well that to put the machine into an already established brick-yard where we could not have full and absolute control would probably lead to failure, an abandoned yard at Pea Shore was rented, the remains of an engine bought and exhumed from under the sand that had drifted over it for years, the machine erected, and all was ready for a final start.

"Why, Chambers! you are not going to start your machine in that 'graveyard' of brick machines, are you?" Every machine ever tried in that clay was a failure (and they were many), hence the name "graveyard."

We started our machine in the early part of '62. It ran beautifully for about fifty seconds, producing nineteen bricks, when a crack was heard, the machine ceased to revolve, and all was silent except the engine; it, being relieved of its load, "ran off." My brother counted the bricks so made in a mournful tone: "N-i-n-e-t-e-e-n b-r-i-c-k-s, and each one cost over one hundred dollars." While he was counting the cost of the bricks I was getting out the broken parts of the machine, and the next train bore me to the shop for a new and heavier spur gear. One was selected, guaranteed by the founder to drive any "mud squirt" that we might ever build. Yes, indeed, that would turn the "sausage stuffer."

At this critical period I would rather have given up my left arm than have had this accident to happen.

Soon the damage was repaired and the machine started, running for the balance of the season, the bricks drying and burning, notwithstanding the many prophecies that they would "go to pieces in the kilns."

Our first order for brick made by this process was from a friend for two small houses; the second for 2,000,000, with the stipulation that, at the option of the owners, the walls were to be measured, if the count was not satisfactory, and settlement made accordingly. Then the new development appeared relative to the quality of these brick. They overran, by measurement, the count, about ten per cent., owing to their superior strength, and consequently little or no waste.

The "lamination" (which was so much feared, criticised and condemned at first), proved to be one of great merit, adding great strength to the brick crosswise.

Clay, like many other materials, arranges its particles lengthwise while being rolled, drawn or forced through dies, hence brick so made were much stronger in cross section than those of homogeneous structure.

The first full-sized machine was replaced at the end of the season with one of improved construction, which has been in constant use ever since. Thirty years is no mean life for any machine, much less for one working in such abrading materials as clay and sand.

Now, all our troubles were over, and we only had to build and sell machines; but, alas! the devices which worked so satisfactorily in one bank of clay refused to operate in that from the other side of the fence.

The man who thinks the inventor has easy work and reaps all the profit is much mistaken.

Every variety of clay presents a new problem. A process or a machine entirely successful in one material, may prove an utter failure in another. To adapt the machine to the various qualities of clay throughout the civilized world has been the work of over thirty years, and the task is not yet completed. Maine, Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, the Carolinas, Florida and Louisiana, each have their peculiar qualities of clay, to say nothing of our long list of Western States.

The clay of Duluth, Minnesota, was a "sticker." It is said of it that if a man goes into the bank to dig, his spade sticks fast, and in the effort to get it out he himself is entrapped, and another man is required to get the first one out. A machine, eminently successful in a hundred different clays, was an utter failure at Duluth.

Each failure, however, was but a spur to renewed effort. The nature of the new material was carefully studied, the machine modified to suit its requirements, and, strange to say, every change so made was for the betterment of the machine for all the clays it had previously worked.

The first complete automatic expressing brick-making machine (producing about thirty thousand brick in ten hours) was a cumbersome, heavy affair, and of too great a capacity for the many then would-be customers. A machine of less weight and cost was much sought after and we set about to produce one small and inexpensive for the smaller towns and villages, and proposed to call it the "Village Brick Machine."

In the designing and construction of this machine all the little points learned by experience were embodied, the exact proportions of each part with another carefully studied and calculated, and a machine produced that instead of being of small capacity nearly trebled the output of its larger and older brother.

A working model of this machine was exhibited at the Centennial.

Not to be thus baffled, a third effort was made to produce a machine of small cost and capacity. Taking advantage of the still greater experience in clays from various parts of the world a machine was produced still more complete in detail and reliable in operation, but in capacity still far beyond the requirements for the "village."

A fourth effort resulted in the production of one sufficiently meager in its output, but so simple in construction and "kind" and efficient in operation that its novel features are accepted to-day for the production of the best quality and the greatest quantity of common brick.

Taking the best parts of these three later machines and embodying them into one grand whole, we have what is known as the "B-CD," each of its predecessors being styled in its turn the A, the B, the C and the D.

Thus you see how our most successful machine, the B-CD, was evolved.

During these years many other inventors and experimenters were engaged in efforts to improve the ceramic art. No better evidence of this can be adduced than of the 24,721 patents issued by the United States Patent Office alone for improvements in machinery and kilns, to say nothing of those of foreign countries. Three hundred and twenty-three patents were granted in the United States for screw machines, 442 for reciprocating, 305 for rotary, 394 for tile machines, and 467 for improvements in kilns.

It is no small task for the brick-maker to select the most efficient machines and kilns for manufacturing brick from the above list. Indeed, not one in a hundred of them are at all practicable, and most likely that one is so poorly constructed as to be wholly worthless.

Certain processes are well adapted for one material while wholly unfit for another. One clay, say the natural prepared "malin" of the Mississippi and other rivers, is adapted to the dry clay process; while another, the tenacious argillaceous material, requires an entirely different mode of working. One clay will require and stand much tempering and be improved thereby, while another will be ruined if over tempered.

Beware of the man whose machine will work all clays.

The price of a machine has but little to do with its selection, the very best is poor enough. A machine that will save its cost in from three to six months is not dear at any price. To-day the best machines are fitted up with the greatest accuracy, of the very best materials, replete with all the little conveniences for their care and preservation; all parts made to interchange, and those in contact with the abrading materials easily and cheaply renewed.

One machine may look just like another to the brick-maker unskilled in mechanics. Yet one is complete in detail, working "day after day, week after week and month after month," without interruption, while the other is constantly being stopped to fix this, that and the other, and at the end of the month not half the rated output is realized. The best evidence of the value of an invention is its piracy.

In the selection of machinery for the preparation of clay, making of brick and burning, it is well to throw the risk of a trial upon the parties selling. Let them be at the expense of erection and testing an untried machine or kiln in a new material, and you make your decision after making and burning say half a million of brick by the new devices.

Probably nine-tenths of the brick consumed in the United States to-day are made by machinery, and what is the effect of this change upon the brick-maker? In the early part of this paper you had a "word-picture" of the "old-timer" bespattered with mud from head to heels, working like a beaver to produce, during the warm months, a few misshapen bricks, which he disposed of as best he could and spent the remainder of the year at some other occupation, thereby eking out a living for the balance of the year.

The brick-maker of to-day is raised to the dignity of a manufacturer—carrying on his business all the year round—employing steam by the hundreds of horse power, digging his clay by steam, carrying it to the machine house by rail, dumping it into large hoppers, and performing all the various manipulations of screening, mixing, tempering, molding, drying and burning without being exposed to weather, and never touching the clay with hands until it issues a completely molded brick. He has his "yard office" and his "city office" and clerks; and if he understands his business, a large balance in bank, a nice square brick of "bonds," and a few corner lots, a row or two of houses, and a nice one for himself and family to live in, and is respected amongst men. He is no longer the despised slave of the Egyptians. *Cyrus Chambers, Jr.*

Cyrus Chambers, Jr., inventor of the Chambers brick machine, which is now so extensively used in the manufacture of paving bricks, was born at Kennett Square, Pa., in 1833, of Quaker parentage. He manifested great interest in machinery at a very early age. At seven years he began the winding of bobbins in his father's woolen mill; at ten he constructed an overshot water wheel eighteen inches in diameter, to one end of the shaft of which was attached a model of his father's saw-mill. To the other end of the shaft was a diminutive "fulling mill." This wheel drove also a threshing machine capable of threshing one head of wheat at a time. A monkey laboriously turning a grindstone and various other figures adorned this miniature of his father's mill. The neighbors came from all directions to see this wonderful production of the "small boy." At the age of twelve he was power loom boss in his father's factory. At thirteen he built a small steam-engine, in brass, to embody some improvements in expansion and condensation, and, although now in his sixtieth year, is still working upon that same problem. In his sixteenth year he commenced the study of dentistry with an older brother and during the first seven months constructed the "Golden Miniature Steam-Engine," a high pressure beam engine, the cylinder of which is one-sixteenth of an inch in diameter, and three-sixteenths of an inch in stroke. It is composed of over one hundred and fifty pieces, some so small that they can

scarcely be seen by the unaided eye. The screws are of steel, turned in a lathe. The fly wheel, boiler and bed plate are of silver, and the whole weighs less than one-half an ounce. At the age of twenty he invented the Book and Newspaper Folding Machines which have gone to all parts of the civilized world, and to-day fold nearly all of the books published. Seven years later he invented the leading features of the brick-making machine which to-day produces millions upon millions of brick in various parts of the world. For the Chicago market alone, his machines produce about six hundred millions annually. He has taken out almost one hundred patents in this country and in Europe, and to-day works in his private mechanical laboratory as industriously as ever, developing new inventions. Residing in the suburbs of Philadelphia, in a house surrounded by all the modern appliances for comfort, he enjoys the autumn of his well spent and busy life.

TWO METHODS OF GETTING DIRECT HIGH PRESSURE FROM WATER-WORKS PUMPS.

In most of the lesser cities and in nearly all of the smaller ones and large towns having a public water supply, it is customary to depend in some measure upon direct connection of the fire hydrants with leading lines of hose, for fire-streams, both for use against incipient fires and in case of wide-spread conflagrations.

This use varies from the slight requirements in the first instance, to that where the water-works hydrants are relied upon for the principal protection against fire, the fire engines forming a reserve force in case of accident, needed increase of the number of streams or of extremely long lines of hose.

So thoroughly does a good water-works plant assist the efforts of the firemen, that streams from such plants are desired by them as the most effective attainable; while both parties recognize the exigencies requiring the retention and use of steam fire engines.

It therefore becomes a question how far the principle of direct pressure from the pumps can be advantageously applied to fire protection. This question is not entirely one of population or of pumping capacity, nor can the burning of a few tons of coal be taken as its measure, but it must be settled by the relation of pumping capacity to consumption,

If the pipe system is well designed, able to convey the volume of water required without undue loss from friction and the pipe itself able to stand the strains and shocks arising from direct pressure, then direct pressure is desirable for fire protection, so long as the ordinary consumption, plus the waste due to the increased pressure, still leaves a safe margin, within the capacity of the pumps, for all fire streams likely to be needed (supposing no scarcity of water to exist).

This condition will, therefore, vary not only with different cities and plants, but also with each city and plant at varying seasons of the year and at different hours of the day.

Many cities and towns are supplied entirely by direct pressure; so that the advantages to be derived therefrom for fire protection are already theirs. It has, however, been found that in all cases where practicable, it is desirable to supplement the pumps by storage reservoirs at sufficient elevation to supply the ordinary consumption and in some instances at elevations sufficient for fire streams.

While in the smaller cities, where suitable elevations for the construction of reservoirs do not exist, in order to avoid the expense of continuous pumping, especially during the night, recourse is had to stand-pipes of iron or steel to act as small reservoirs, but which, owing to the topography of the surrounding country, are seldom sufficiently high to afford efficient fire streams. In order to take advantage of the pumps for direct pressure, gates are usually introduced in the main connecting with the reservoir or stand-pipe, by which they can be shut off and the whole power of the pumps applied through the distribution system. In some cases the reservoirs or stand-pipes are connected with the distribution system only by the force main via the pumping station, where, by proper gates and connections, the force main can be cut out without interfering with the distribution, which thus become subject to direct pressure. Other means have been adopted by different engineers to obtain this much-desired result, with varying degrees of success. A description of two of these methods tried by the author may, therefore, be of interest to others studying the same problem.

The first method was suggested by the striking apparatus connected with the bell of an ordinary fire alarm, viz., motion by means of a weight suspended to a wire rope wound around a drum connected by revolving gears to a ratchet wheel, from which the pawl was released by magnetic action produced by a current of electricity.

The details of this scheme were worked out by the "Coffin Valve Manufacturing Company" of Boston, Mass., and the apparatus was attached to one of their 10-inch gates in the vertical 10-inch supply pipe to the Racine, Wis., stand-pipe in the spring of 1887.

The apparatus was set so that the axle of its drum was in line with the spindle of the gate, to which it was attached by a socket extension.

When the pawl was tripped the fall of the weight was retarded by a fan, attached to the axle of the ratchet wheel, whose angle of striking the atmosphere could be changed so as to regulate at will the length of time required for the weight to drop and in which to close the valve; the time required in this instance, so as not to jam the valve, being found to be about thirty seconds.

The pumps being run slowly at the time of tripping the valve, which is done from the pumping station, the engineer is not taken unawares, and no water hammer occurs, but, watching his gauge, he carefully increases the engine speed till the proper pressure for fire streams is attained, after which only the same watchfulness is required as in ordinary direct pressure.

The stand-pipe in this case is situated on a pedestal 55 feet high, and furnished with separate inlet and outlet pipes; the former 10-inch diameter, fitted with the gate already described: the outlet pipe 16-inch diameter, with gate and check valve; while the inlet pipe rises from the outlet pipe just on the pump side of the check valve.

The pipe, gates, weights and apparatus, are contained within annular chambers 4 feet wide and 15 feet high, within the pedestal.

Electrical connection (open circuit) is made between the stand-pipe and pumping station, one and one-fourth miles apart, with the usual size galvanized iron wire, with the exception of across the Root river, where there is a submerged cable connection. At the pumping station there is a battery of the usual power required to work a fire-alarm circuit of equal length, and the pawl at the stand-pipe is tripped by merely closing the circuit by means of a switch in the engine-room of the pumping station. The mechanical operation of the apparatus was perfected by Mr. S. W. Harris, the engineer first in charge at the pumping station, since which time no difficulty has been experienced in shutting the gate at will from the engine-room.

The following year a duplicate of this apparatus was connected with the stand-pipe at Janesville, Wisconsin.

The practical difficulties attending this method have been found to be first, the necessity of sending a man to the stand-pipe to open the gate whenever closed; second, the tripping mechanism is so delicate as to be operated sometimes by electric storms.

Neither of these objections are serious when compared with the benefits derived from the ability to close the gate at will, but yet were sufficient to lead the study resulting in the second method, whereby the gate is controlled, or can be both opened and closed at at will, from the pumping station.

The first device for this method was put in two years ago at Marion, Ohio, where the distance between the stand-pipe and pumping station is three and three-fourths miles by the pipe line. In this case the inlet is also the outlet pipe, and is 16-inch diameter.

The device consists of a 16-inch gate operated by hydraulic pressure, inserted in the main pipe line between an ordinary gate at base of stand-pipe and another gate in the street This hydraulic gate, and water cylinder, rests on its side and is an ordinary "Chapman," bell end, hood gate, with composition covered steel piston rod and stuffing box, instead of screw spindle with 10-inch composition lined cast iron cylinder, connected to hood of gate by a suitable yoke; the piston used is of the same type as that for ordinary hydraulic work, and is fitted with hydraulic packing (double leather cups). Each end of the hydraulic cylinder was tapped for one-quarter inch pipe, and when ready for work was connected with corresponding ports of the operating valve, which latter occupies the same relation to the working of the hydraulic cylinder as the steam chest does to the steam-engine; the intake port of this valve was connected with the 16-inch main by two lines of three-quarter inch pipe one on each side of the 16-inch gate, each line being fitted with gate and check valve, and the lines being united before reaching the operating valve; the object of this double connection being to utilize the pressure in the main pipe line on that side of the gate where it should be greater. It will been seen that by throwing the pressure through the operating valve, into the end of the cylinder next to the gate, the gate will open, while if the pressure is applied to the other end the gate will close, the exhaust being back through the exhaust ports in the operating valve.

This operating valve was designed by A. H. Holland, civil engineer, and consists of a cast iron shell, composition lined, of about two inches interior diameter, and having transversely of the cylinder, five ports one-quarter inch wide, one for the inlet, two for the operating, one connecting with each end of the hydraulic cylinder and two exhaust ports. On a one-half inch valve stem are three brass pistons, three-eighths inch thick, so arranged that a movement of the valve stem of five-eighths inch will divert the pressure to the operating port at one end of the cylinder and cut off the exhaust at that end, while the same motion will shut off the pressure, and put the operating port and exhaust in connection at the other end.

The pipe used was three-quarter inch reduced at the operating valve and at the hydraulic cylinder to one-quarter inch. Under these conditions and with a stand-pipe pressure of about 45 pounds the 16-inch gate opens or closes in 45 to 50 seconds.

In order to light the pumping station, and also to furnish means of controlling the operating valve, there was erected at the pumping station a small, high speed, vertical steam-engine, of five-horse power and an arc dynamo capable of the same effort. At the operating valve was set a lifting magnet, capable of lifting 200 pounds. This magnet consisted of two pair of spools, set in a cast iron frame, above which was attached a rocking arm, carrying at each end a heavy bar of soft iron; the motion of this rocker arm necessary to bring either bar of iron in contact with its own particular pair of spools was about one-quarter inch; on top of this arm was attached another, of sufficient length to give the proper length of stroke to the operating valve, with which it was connected by a rod and bell crank. An insulated copper wire (No. 8, B.W. G.), was run from each pair of spools at the lifting magnet (two wires required) to the switch board at the pumping station, where a three way switch set on the center cuts the electrical current out from both wires; set on either side, diverts the current to and through the pair of magnet spools wired to and connected with that point, instantly attracting the bar of soft iron attached to the rocker arm and thus moving the operating valve as desired, and through that the main gate.

Shortly after the erection of this apparatus, a duplicate was erected at Decatur, Alabama, and during the two years that have since ensued, the magnets at either place have never failed to respond to the application of the electric current at the switchboard at the pumping station; in fact the engineer at Marion states that by actual trial he has found it impossible to make and break the contact so quickly as to fail to work the magnet and valve. During these two years the valves have been operated at least twice each week to make sure that connections were perfect, valves in working order, etc., but the magnets have never worked except when the current was turned on to them at the switchboard.

The only difficulty developed in operating has been that the hydraulic cylinder was not large enough to overcome the drag of the gate upon its seat in starting to open it, if the pumps were stopped and full stand-pipe pressure thrown on one side of the gate; as, however, this was easily remedied by slowing down the pumps till the pressure became the same as that of the stand-pipe, and operating the gate while it was thus balanced, no practical difficulty has been experienced, while to guard against isolation of the stand-pipe in case of a burst on the long force main, the hydraulic gate is "by-passed."

In building new it might be desirable to construct the hydraulic cylinder of the same diameter as the gate itself.

It was complained at one time that the gate opened quicker than it closed, but an examination developed the fact that this was apparent rather than real, the closing not showing on the gauge till the gate was nearly shut, while its effect was noticeable in opening to the same extent, but in the first case at the end and in the latter case at the commencement of the piston travel.

The success of this second method of securing direct pressure has been such that it can be confidently recommended wherever it can be applied. If in a city where there is always maintained a 24-hour electric service, the expense of steam-engine and dynamo could be avoided.

If all machinery is standing still at time of the alarm, the engine and dynamo can be running full speed before the main pumps will be ready to "speed up," and whether running or not can all be ready to respond to the call of the Chief of the Fire Department by the time he can get upon the ground and determine that he wants direct pressure.

There are no patents on the combinations by which this result has been secured.

Geo. A. Ellis.

CURRENT INFORMATION.

SAND FOUNDATIONS FOR PAVEMENTS.

In the December number of PAVING AND MUNICIPAL ENGINEERING a letter was published on the subject of sand and gravel foundations for brick pavements, the authorship of which was attributed by mistake, as we have since learned, to Charles P. Chase, of Clinton, Iowa. It is due that the explanation should be made even at this late day that the author was Mr. B. B. Hart, city engineer of Clinton, Iowa, instead of Mr. Chase. Some additional information is given by Mr. Hart in correspondence with him on this subject as follows:

"In my railroad experience, having been successful in building permanent mechanical structures, culverts, upon a quicksand foundation, without piling, the sand being thoroughly confined, where heavy locomotives and trains were often passing rapidly over it, I have implicit confidence in a properly constructed sand foundation. I have often regretted that I did not substitute sand in my first specifications for brick pavement here, as the sole foundation."

IGNORANT OPPOSITION TO STREET PAVING.

In enlightened communities it is well understood that there can be no more profitable expenditure of money than for needed public improvements, but there are many non-progressive towns in which there is amazing ignorance of the benefits to be derived from such work. A remarkable instance of this is brought to attention by a newspaper report of a recent meeting of citizens in Xenia, O., to protest against the proposed paving of a street there with brick. Various absurd objections to the improvement were offered, concluding, finally, with a plea by one citizen, a physician, for abolishment of the use of the street scraper, because "it hauled off material that should be used for filling." This, indeed, is a hopeless case.

PUBLIC WORK IN MEMPHIS.

The annual report of Niles Meriwether, city engineer of Memphis, for 1892, is thorough, interesting and valuable. It comprises over a hundred pages, fully illustrated, and contains much useful information regarding the public work done in Memphis. The statistical part of the report shows that different kinds of paving have been laid in Memphis at an average cost as follows: Cedar block, 32,799 square yards, $1.92 per square yard; granite blocks on concrete, 46,394 square yards, $4.35 per square yard; brick on concrete, 34,004 square yards, $2.90; granite blocks on gravel, 5,240 square yards, $1.91; limestone blocks on gravel, 246,726 square yards, $2.15; limestone blocks on concrete, 3,548 square yards, $3.65; Telford and macadam, 229,752 square yards, $1.15. The report embraces also a complete review of the sewerage of Memphis, to which there was added during 1892, 1.37 miles of the Chelsea system. During the year fifty-one stoppages were removed from the fifty miles of sewerage at a cost of $106.20, an average of $2.08 per stoppage.

THE PROPOSED NATIONAL ROAD DEPARTMENT.

Col. Albert A. Pope, the indefatigable advocate of governmental direction of road improvement, has published in a pamphlet of a hundred pages, a memorial to Congress on the subject of creating a national road department, and also further urging an exhibit of roads, their construction and maintenance, at the World's Columbian Exposition. The memorial sets forth the indorsement of Col. Pope's plans by hundreds of men prominent in public life, newspapers, legislatures and official bodies. In speaking of the petition circulated by his direction, he says: "Many persons objected to signing this petition for a road department because they believed that roads were of such comparative importance that a department was unnecessary, and a bureau in the agricultural department would be sufficient to accomplish all that was necessary. Substantially this view was taken by a great many editors of newspapers, who, through their columns, urged their readers that it was not advisable to sign the petition unless the word 'bureau' was substituted for the word 'department.' The governor and the justices of the Supreme Court of Rhode Island signed a petition after they had stricken out the word 'department' and substituted 'bureau.'

"In this connection it should be stated that it has been maintained in the columns of some newspapers that the creation of a road department necessarily meant the appointment of another cabinet officer. I do not believe it was the wish or intention of the signers of the petition, as it surely was not mine, to enlarge the number of cabinet officers.

"I believe that all those who objected to there being a department erred because they did not fully realize the paramount importance of the subject. A glance at the statistics of the nation would remove this erroneous impression. For example, Poor's Manual gives the capital of the railways of the country for the year 1891 as $10,122,000,000. I venture to assert that the value of the land upon which city streets and country roads are built, and the cost of the construction and maintenance of these streets and roads exceeds in amount the cost of the railways. In other words, I do not hesitate to say that the streets and roads of the United States represent a value of ten billion dollars, a sum far greater than the total valuation of all the real and personal property in the United States in 1850.

"It is absurd to assert that this amount of property is of so little consequence to the nation as not to justify a department of roads. I find in the report of the Inter-state Commerce Committee for the year 1890 that the number of railway employes in this country was 749,301. The population of the United States in 1790 was 3,929,214. Assuming five persons to a family, it is probable that the railway employes and members of their families are in number greater than the entire population of the United States at the close of the Revolution, and I believe it may be assumed that there are employed in the constrction and maintenance of city streets and country roads as many persons as are employed on the railroads.

"Objection was made to signing the petition by a large number of citizens and by some newspapers of the country, because, as they understood the phraseology of the petition, it had for its object the construction and maintenance of national roads. Such a misconception seems inexplicable. Surely language could not more clearly express that the object of the road department was simply to promote knowledge in the art of construction and maintenance of roads.

"The proposed road department need not necessarily be limited to the promotion of knowledge in the art of the construction and maintenance of city streets and country roads—it might also embrace railways, and such department might be expanded as to take up the question of transportatian and be virtually a transportation department."

CONVICT LABOR AND BRICK-PAVED HIGHWAYS.

Mr. A. O. Jones, World's Fair Commissioner for Ohio and president of the A. O. Jones Brick and Terra Cotta Company, advocates the use of convict labor in making paving brick for use in paving the public highways. In urging the adoption of his plan in Ohio he says: "There is no reason why we should not erect work-houses in locations where suitable shale, clay and coal can be procured at reasonable prices, and near good railroad shipping points, and have the convicts employed at brick-making inside of inclosures, and even turn the present penitentiary into a huge brick plant, the clay and coal to be unloaded and the brick loaded back on cars, and all the railroad switching to be done at night when the prisoners are safe in their cells, stamping every brick with O. C. L. —Ohio convict labor—and impose a heavy fine and imprisonment if they are used for any other purpose than road-making and state purposes." Mr. Jones's ideas received very favorable consideration from members of the Ohio legislature.

DISPOSAL OF SEWAGE.

Prof. F. O. Marvin, of the Kansas State University, is giving a series of lectures in Kansas City on municipal and domestic sanitation. In the last of these he talked about the disposal of sewage and in discussing the subject said:

"A complete system of town drainage should include: First, impervious sewers; secondly, storm water sewers, and thirdly, sub-soil drains. Few towns have all three of these sets. Generally large sewers are designed to carry the storm water, and are placed deep enough to catch the sanitary sewage. These also act as sub-soil drains because of the pervious character of the materials of which they are made.

"In form they should be adapted to give the greatest economy of material and cost, and the greatest strength and freest flow. For smaller pipes cast iron or clay have been used, and have the advantage of being impervious. For the larger size, brick, concrete or stone is used. But through these materials the ground water will come in, or, under pressure, the sewage may be forced out and so pollute the soil.

"The size of a sewer depends on the density of the population, the amount of waste water, grades, the materials, the extent of the system, the variations in sewage flow and the amount of storm water that will reach the sewers. The carrying of waste water is usually assumed in America at from fifty to seventy-five gallons per head per day. As to the density of population, 30,000 to 200,000 people to the square mile has been assumed. Sewers can not be designed to carry the rainfall from excessive storms. The cost would be too great. So English and American practice assumes a rainfall of from one to two inches per hour, one-half of which will reach the sewers within the hour, as the basis of calculation.

CLOSED CONDUITS FOR ELECTRIC STREET RAILWAYS.

In a paper read before the Buffalo Electrical Society, on March 6th, Frank C. Perkins described the several patents for closed conduits to take the place of the trolley in the operation of electric street railways, including his own, and in discussing questions as to whether closed conduits will supercede the trolley in large cities, said:

"It would be folly for any one to assert that the trolley system for operating electric railways will be thrown out of use in small cities, villages and rural districts; and until some efficient, practical and reliable closed-circuit system is brought before the public, the trolley will still continue to be used in the large cities as well.

"A conduit system, however simple, could not compete with the trolley in the country, where long lines are necessary, and where wooden poles and a comparatively cheap line construction give good satisfaction to the railway company, and is not seriously objected to by the public.

"In large cities, however, where the trolley system is so greatly objected to, on account of the so-called "unsightly overhead wires," the conduit system, when perfected, will find many advocates, and will be readily adopted by street-railway companies interested. After looking at a street crossing in Boston, with its network of wires as used in the trolley system, and then noticing the entire absence of overhead conductors in the city of Buda Pesth, Hungary, one is impressed with the advantages of the conduit system as well as the great difficulties under which our firemen have to work. Regarding the cost of construction, a conduit system would compare very favorably with the trolley in cities where the authorities insist on the feeder-wires being placed in underground conduits and where an expensive line construction, with iron poles, guard-wires, etc., is required.

"The systems now in use for operating electric railways are, 1st, the trolley, and second, the open-slot conduit. Every one is so familiar with the trolley system that to go into details regarding its operation would be a waste of time; but we are not so familiar with the open-slot conduit as it is not in general use at present.

"The Siemens and Halske system has been in use for some time in Buda Pesth, Hungary. The Love system is now in operation in Chicago, and the Bentley-Knight system was operated a short time in Boston, but has not been in use for several years. The greatest difficulty the companies using the open-slot conduits have to contend with is maintaining a good insulation for the main conductors, the loss of current through leakage in wet weather being sometimes very great. Many methods have been proposed whereby closed conduits might be used, thus avoiding the misuse of the conduit for a sewer, as is often the case with open conduits''

COST OF PUBLIC WORK IN WASHINGTON.

Capt. G. J. Freiberger, corps of engineers, U. S. A., assistant to the engineer commissioner of District of Columbia, in his annual report for 1892, shows that with the work done during the year, Washington now has street pavements as follows: Street pavement, 2,064,999 square yards; asphalt block, 270,459; stone block, 544,157; rough stone, 319,031; macadam, 287,917. This paving covers 66⅔ per cent. of the streets of Washington. The work done during the last year was by contract at the following prices:

Sheet asphalt on 6-inch concrete base, exclusive of grading, per square yd.	$		2 25
Sheet asphalt on 4-in. bituminous base, exclusive of grading, per square yard			2 00
Asphalt block on gravel base, exclusive of grading, per square yard			2 00
Granite block on gravel base, exclusive of grading and cost of block, per square yard			95
Granite blocks delivered at yards, $43 to $46 per M, per square yard	1 80	to	1 93
Ordinary macadam, 12½-inch thick, exclusive of grading			92½
Telford macadam, 8-inch base, 5½-in. macadam, exclusive of grading			99½
Brick sidewalks, exclusive of grading and price of brick, per square yard	20	to	31
Relaying same, exclusive of grading and price of brick, per square yard	20	to	36
Bricks, paving, delivered on street, $10.89 per M, per square yard			38
Tile walks, exclusive of grading and price of tile, per square yard			42
Vitrified tile, delivered at yard, $36 per M, per square yard			58
6 by 20-inch granite curb set, exclusive of cost of curb, per linear foot	16	to	25
6 by 20-inch granite curb, delivered at property yard, per linear foot			99
8 by 8-inch granite curb on 6-inch concrete base, exclusive of cost of curb, per linear foot	40	to	50
8 by 8-inch granite curb, delivered at property yard, per linear foot			87
Resetting 6 by 20-inch curb, per linear foot	09	to	16
Cobble gutters, exclusive of cost of material, per square yard	16	to	20
Vitrified brick gutters on 6 inch concrete base, exclusive of cost of brick, per square yard			1 27
Vitrified brick, delivered at property yards, $16.88 to $19 per M, per square yard	1 01	to	1 14
Cobble taken up and removed to property yards, per square yard	08	to	15
Old curb taken up and removed to property yards, per linear foot	05	to	08
Grading earth, 500 feet haul, per cubic yard	18	to	40
Grading macadam, 500 feet haul per cubic yard	35	to	68
Hauling earth and macadam each 100 feet over 500, per cubic yard	00¼	to	01½

MASSACHUSETTS HIGHWAY ASSOCIATION.

The Massachusetts Highway Association has been organized, with W. E. McClintock president, and C. R. Cutter secretary. The purpose of the association is to extend acquaintance among members, present papers and discuss progress and to visit different fields of work. The charter members include some of the most progressive road engineers of the state. President McClintock is at the head of the road engineering department of the Lawrence Scientific School, of Harvard college, and is a member of the Massachusetts State Highway Commission.

COST OF HIGHWAYS IN ENGLAND.

The annual cost of maintenance of main highways in the county of Hampshire, England, averaged for the nine years ending March 25, 1889, the sum of $125.97 per mile. The total mileage in the county was 382 miles in 1880, and 532 miles in 1889. The proportion in 1889 was 490 miles in the rural districts and forty-one miles in urban districts, the average cost of maintenance of the former in 1889 was $97.80 per mile, and of the latter $531.77. Besides the main highways there are in the county about 3,100 miles of rural roads, maintained at an expenditure of about $100,000 per annum, and about 210 miles of urban district roads, on which some $65,600 is expended, or an average per mile of $32.30 and $312.40, respectively.

SOME RECENT INVENTIONS.

A Curb Box Cover. 492,227. Daniel O'Neil, Rochester, N. Y. This invention comprises an annular, internally shouldered bed piece adapted to be secured to the top of the pipe, the bed piece being provided with two internal, spiral segmental ribs, diametrically opposite each other, each having its lower end abruptly inclined downward, and having its upper surface substantially horizontal, and its lower surface inclined downward, and a cylindrical plug adapted to fit within the bed piece, and having shoulders to engage with the shoulders of the bed piece, and also with two projecting bosses diametrically opposite each other to engage with the spiral ribs of the bed piece, the upper face of each of the bosses being flat to engage with its respective rib, to secure to the plug in the bed piece, and the lower face being beveled or inclined to engage with the inclined end of the rib and raise the plug out of the bed piece.

A Drain Pipe. 492,191. Alonzo W. Cram, Haverhill, Mass. This invention comprises a pipe section having an opening, a cover therefor, a yoke secured over the cover which is formed with a cross slot or recess and an intersecting vertical recess, a screw-threaded nut adapted to be inserted in the cross slot, and a screw adapted to be adjusted through the nut and vertical recess in the yoke for the purpose of clamping the cover in position.

Pipe Coupling or Fitting. 492,159. George W. Harrington, Wakefield, Mass. This invention comprises a hard metal shell internally screw-threaded and having two internal enlargements, a lead lining or bushing formed within the shell and screw-threaded at its ends to form lead continuations of the screw threads at the ends of the coupling, the intermediate portion of the shell and lining projecting inwardly and forming shoulders against which the ends of the pipe sections abut.

A Bridge Gate. 492,387. Theodore F. Conklin, assignor to Nathan S. Lepperr, Chicago, Ill. This invention comprises pivoted guard bars of pivoted and horizontally movable levers, the inner ends of the levers being connected together and extending outwardly in position to be operated by the swinging bridge, and forming a double incline, and connections uniting the outer ends of the levers to the ends of the pivoted guard bars.

A Levee and Dam Structure. 492,704. George P. Anderton, Concession, La. This invention comprises a boxing composed of a series of sections secured together and a plurality of crown or top pieces adjustable to and from each other.

A Sewer Guard. 492,450. Samuel T. Williams, Baltimore, Md. This invention comprises a frame mounted in the sewer opening, rotary devices located in the opening and mounted in the frame and adapted to be revolved automatically by the water flowing into the sewer.

A Street Sweeper. 492,487. Patrick Reardon, Paterson, N. J. This invention comprises a broom having a broom head provided with a hole to receive the end of a pole, the pole and a clip provided with side braces, a bracket secured to an axle, the bracket being provided with projecting lips formed to embrace the side of the pole of a handle, rubber cushion washers inserted between brace arms and the pole or handle, and wheels secured to the axle, the pole being provided with two series of holes to permit the pole to be secured to the bracket arm at different parts as desired.

A Street Sweeper. 492,489. Francis C. Williams, Philadelphia, Pa. This invention comprises a traveling support, a containing receptacle, a revolving brush, a carrier, arms by which the carrier is pivotally connected to the machine, and gearing adapted to occasion the elevation of the carrier.

V. H. Lockwood, Patent Att'y.
Indianapolis, March 23, 1893.

RECENT LEGAL DECISIONS.

Construction of Railroad in Street—Duty of Company to Restore Street to Former Condition.—License from a city council to a railroad company to build its road across, along or upon a public street gives it no power to destroy the street, and the company is bound to restore the street to its former state, or to such state as not unnecessarily to have impaired its usefulness for the public, and also to build proper crossings over the railroad and keep them in good repair. If it fails to do so the company may be compelled to do so by mandamus; and, as the company is guilty of maintaining a nuisance, equity may entertain a bill to abate such nuisance, and may compel the company to perform its duty. City of Moundsville *v.* Ohio R. Co., Sup. Ct. Appeals. W. Va., 8 Notes of Cases 15.

Agreement Contrary to Public Policy—Railroad Company Closing Streets—Suit by City.—An agreement by a city not to oppose a railroad company's closing certain of its streets crossed by the latter at a grade in consideration of the making of compensation solely to private individuals is void as against public policy.

The invalidity on the grounds of public policy of a contract by a city with a railroad company will be considered by the court in an action to enforce it although such validity is not pleaded.

A municipal corporation can not become a trustee to collect in its own name, especially at its own expense, separate sums of money due to some of its citizens for damages from the closing of streets by a railroad.

A contract between a city and a railroad company by which the former consents to the closing of certain streets upon the consideration that the latter shall pay certain damages to thirty-five different property-holders, if enforcible at all, can be enforced only by such property-holders.

A demurrer to a complaint by a city upon a contract between it and a railroad company by which it consents to the closing of certain streets on condition that the company pays to thirty-five different property-holders injured thereby the damages sustained, must be sustained even if such property-holders have a right of action thereunder, since such rights would be several and not joint, and the court is not required to select and substitute one of the thirty-five claimants in place of the city. City of New Haven *v.* New Haven & Derby R. Co., Conn. Sup. Ct. Errors, 18 L. R. A. 255.

Street Railway Company Using Bridge Belonging to State.—A street railroad which lays its track across a bridge constructed and maintained by the State, and constituting a part of the highway on which the railroad line runs, does not adopt the bridge as one of its appliances so as to become liable for an injury to a passenger, caused by defects therein, to the same extent as if the bridge had been built by the company. Birmingham *v.* Rochester City & B. R. Co.,

N. Y. Ct. of Appeals, 32 N. E. Rep. 995.

STREET-CROSSING STONES.

Engineering News advises that crossing stones should never be smooth or made of a stone that will wear smooth. Sandstone, though wearing somewhat rapidly, is one of the best materials for this purpose. But if granite is employed, the top surface should be hammer-dressed. No crossing stone should be more than ten inches wide; and if two rows are required, it is well to put one or two rows of paving blocks between them. New York practice, however, does not quite agree with these requirements. Granite, in comparatively narrow blocks, is generally used, and it soon wears smooth. They are very frequently renewed in much-traveled streets. As any crossing-stone is more or less liable to cause horses to slip, they are in that sense a nuisance, and the fewer there are of them the better.

PERSONALS.

Mr. Frank P. Johnson has been elected city engineer of Waltham, Mass.

Mr. Alexander Potter, of Olean, N. Y., has opened an office at 137 Broadway, New York.

Mr. Walter Lodia, of Paris, is in this country, and will represent several English publications at the World's Fair.

D. J. C. Arnold, of New London, O., has issued an attractive catalogue of his brick and tile makers' supplies, freely illustrated.

Mr. Wm. Smith has been elected engineer for Wilmerding, Pa.

Prof. William H. Burr has been appointed professor of civil engineering in the School of Mines at Columbia College, New York City.

Mr. James B. Gass, city engineer of Fort Smith, Ark., has been engaged to prepare plans for a complete sewer system for Jefferson City, Mo.

Mr. Campbell G. Ellwood, formerly superintendent of the Philadelphia Gas Company, has been appointed assistant superintendent of the Department of Public Works of Pittsburgh, Pa.

The following have been appointed as highway commissioners for the state of Vermont: Col. Geo. W. Hooker, of Brattleboro; Prof. J. W. Votey, of Burlington, and Hon. O. L. Hinds, of East Higate.

Mr. F. A. Dunham, engineer in charge of street improvements at Olean, N. Y., has been reappointed city engineer of Sewickley, Pa., where extensive paving and sewerage improvements are being made.

Mr. F. F. Foote, formerly city engineer of Kenosha, Wis., has resigned that position to enter into the contracting business with Mr. P. W. Galloway, of Racine, Wis. Racine will be the headquarters of the new firm.

The following officers have been elected by the Canadian Society of Civil Engineers: President, E. P. Hannaford; vice-presidents, Thomas Monroe, P. A. Peterson and W. J. Jennings; secretary, C. H. McLeod; treasurer, Herbert Wallis.

LETTERS FOR THE PUBLIC.

CONCRETE OR ARTIFICIAL STONE FOR STREET PAVING.

To the Editor of Paving and Municipal Engineering:

Sir—I see in your valuable magazine, discussions as to various kinds of street paving, but I have seen nothing about the use of concrete and artificial stone for paving streets. Have streets been paved with cement stone? Is there any reason why this material will not make a first-class street pavement? I have heard that streets have been paved as above in some towns in Canada, also in northern New York. I would be glad if you would answer through your magazine, as a matter of information to the writer as well as your other readers.

Paver.

Mobile, Ala., March 7, 1893.

[The questions asked in the foregoing communication were submitted by the editor of Paving and Municipal Engineering to Mr. Warner H. Jenkins, concrete engineer and G. W. Bartholomew, jr., secretary and manager of the Buckeye Portland Cement Company, whose answers are given below.]

To the Editor of Paving and Municipal Engineering:

Sir—Referring to your communication of the 13th instant, I have seen the experiment of paving street ways with concrete, and have had occasion to thoroughly examine them after being in position for several years. It is hardly necessary for me to state that the result was a failure. After the crust or trowel finish had worn through, the rougher particles would readily peck out and crumble. At present I can not think of any particular work of the kind, but would emphatically disabuse the idea, where it was to be used for wide street ways, with large traffic.

Warner H. Jenkins.

Philadelphia, March 15, 1893.

To the Editor of Paving and Municipal Engineering:

Sir—Yours of 13th inst., asking if Portland cement has been used for streets in this or any other country, is received. I am glad to see your interest in this subject. It is certain to increase with wider knowledge of the merits of Portland cement pavements. No one familiar with good Portland cement driveways, gutters, etc., can have any doubt about the durability of it under the most trying conditions.

But answering your question: Modern street pavers, while depending upon cement for the foundation of all street surfaces, have apparently had the idea that there was some reason why cement could not be used for the surface. Yet the many roads, aqueducts, bridges, culverts, etc., of ancient times, now in existence, were made with cement, Roman artificial cement. These roads, bridges, etc., after resisting the elements and wear of man for over a thousand years, are in good condition to-day. Modern street pavers have lost sight of that, also of the fact that the oldest sea walls of Europe and Italy are made of cement, and have resisted the strongly disintegrating properties of salt water and sea air and the breaking of the waves on their surfaces for nearly two thousand years, and are still doing their duty. All natural stones under similar conditions have been short-lived.

The ordinary granite and sandstones were put together by the chance quality of cement that nature had at hand to supply. And while the individual grains may be the hardest common natural material in the world the cement holding them together usually disintegrates in a comparatively few years when exposed to moist air and frost.

But Portland cement is a striking illustration of the improvement of art over nature. The best chemical knowledge has been used to so proportion and prepare it that it will withstand the elements and gradually improve rather than disintegrate. It is well known that concrete made of the Portland cement of to-day has more strength when one week old than the celebrated cement that the Romans built their roads with ever had.

Yet, as I say, modern street pavers have in some way overlooked it, or have thought it too expensive to use for that purpose. Often where some government building or elegant residence needed a driveway, or a conspicuous entrance, like that to a livery stable, has been built, they have used Portland cement concrete, and a permanent work was the result. This is the case in Europe and America generally. When neat and durable gutters, curbs and street crossings have been desired Portland cement concrete has been used. Gutters receive harder wear than any other portions of the streets when horses are kept constantly hitched on them, as flies in summer and cold in winter make them paw and stamp their steel-calked shoes against the pavement with great force; and often as one horse is taken away another takes his place.

It is in the gutter that the heavily laden drays and wagons back around and cramp their wheels sideways over the pavement. Portland cement has been standing this wear for a great many years without repair.

Its actual use as the surface of the street is mentioned by Feichtinger in Germany before 1885. It was used on at least a part of the main street of Sioux Falls, South Dakota, two or three years later. A block of the latter said to be taken from the most worn portion of the street was on exhibition at the Indianapolis Paving Exposition and was all that could be desired for a pavement. I have been informed recently that it is unchanged in every respect by age. At Bellefontaine, Ohio, the most severely used portion of the main street was paved with Buckeye Portland cement several years ago, and is entirely uninjured by the constant and severe usage it has received. The surface remains almost as unbroken as the surface of the paper on which I write. If it would be of interest I could give you the specifications used at Bellefontaine. It was laid in small (about one yard square) blocks which are separated by tarred paper and are so arranged that a row can be removed to get at pipes, etc., and replaced without any cutting or injuring the pavement. That is very important and can not be done with any other paving material.

Paving cement can not be surpassed as a non-absorbent body. Its surface is just as the roller used leaves it, rough enough for hoofs to hold and smooth enough to please the driver.

Heat and water soften and soon destroy asphalt streets unless they are constantly repaired, but have no effect whatever on good Portland cement concrete. In fact, all other pavements have their serious faults, but concrete, well made, has, practically speaking, none. It contains the special qualities desired for city street paving, viz.: Health,

agreeableness, durability and economy. *G. W. Bartholomew, Jr.*
Harper, Ohio, March 14, 1893.

LESSONS FROM PAVING AT COLUMBUS, OHIO.

To the Editor of Paving and Municipal Engineering:

Sir—I notice in your valuable magazine many references to the paved streets of Columbus, Ohio, some of which are erroneous. Having constructed about two-thirds of the street pavements here, I am in a position to state the facts. The city engineer's report for 1891–92 shows that there has been constructed about 1,400,000 square yards of street pavement since the passage of the "Taylor Street Improvement Law" in 1886. This would be equivalent to eighty miles of thirty-foot roadway, but as most of our streets are wider than thirty feet between curb lines, the actual miles are given as 70.53. This report does not include several miles completed late in 1892, nor over three miles paved outside of the city limits. Including all of these and some paving done before 1886, the total street paving here aggregates ninety miles of thirty-foot roadway. Taking the engineer's report referred to as a basis, the 1,400,000 square yards of paving is distributed among different materials about as follows:

Hallwood paving block	25	per ct.
Asphalt	17	"
Red brick of various kinds	17	"
Hayden paving block	15	"
Fire-clay paving brick	13	"
Stone block pavement	9	"
Boulder pavement	4	"

I venture the assertion that no city in the country can show so large a proportion of its paved streets in good condition as Columbus. This, if true, indicates that a good plan has been followed, and that not many mistakes have been made in material or workmanship.

A full history of our street paving might be interesting, but would be too long for this communication. I will only refer to the lessons learned as to paving brick, which is coming so largely into use. We have a few miles of pavement made of "red brick" and "fire brick" that have not proved satisfactory. These were constructed on the same specifications as adopted for all streets, but the mistake was made of selecting brick of coarse, porous grain and insufficiently burned. Fortunately this defect was discovered early and the proper cure applied. The common, plain paving brick when vitrified have worn very well, but our best results have come from the use of repressed bricks or blocks which have been burned to a vitrified state.

In selecting the best material the practical test found most effectual is "absorption." Any clay material that will absorb much water will be found deficient in frost resisting and wearing qualities. So great a difference has been found between the ordinary paving brick found in the market and the improved, repressed and vitrified material that has been developed, that the latter is called a paving block as a distinguishing feature of the material.

The size of the blocks used is also larger than the brick commonly used, and we have found that these paving blocks can be made very close to the best paving stone in texture, toughness and durability. When manufacturers reach the point that *all* of their product placed in the market is *as perfect as the best*, then paving blocks made of the proper kinds of clay will be used more generally than any other material for street paving.

The Columbus specifications require a foundation of eight inches of broken stone, rolled with a ten-ton steam roller, two inches of sand, blocks or bricks set on edge and rammed, and joints filled with hot coal tar pitch. The folly of laying a poor paving brick according to such specifications is apparent. If a poor brick must be used, its foundation and finish may appropriately be of the cheapest character.

I have noticed that many of the smaller cities and towns call for a deep curb in their specifications, often as deep as twenty-four inches. This is a needless expense on paved streets. In Columbus the curb is five by eighteen inches, set on six inches of gravel and backed with six inches of gravel. This depth is sufficient, if the curb is properly set, as the perfect lines of the curb on our streets will show.

Ten years ago Columbus was sneeringly called a one-horse town. Its unimproved and muddy streets, and old fashioned buildings gave cause for the name. To-day it compares favorably with any capital city. The direct cause of the change is its general and thorough system of street improvements, which has been legitimate, followed by improved architecture, improved business and improved comfort.

N. B. Abbott.

Columbus, O., March 7, 1893.

DAMAGE TO BRICK STREETS BY ELECTRIC CARS.

To the Editor of Paving and Municipal Engineering:

Sir—In looking over one of our best brick streets, I have come to the conclusion that street car tracks, if used for heavy electric cars, are as detrimental to brick streets as they are to asphalt streets. This street has been down about three years, and is in fine condition, with the exception of the space between the rails and a few feet along the outside of them. This portion of it is bad, having settled about three inches, and in places the rails have worked the brick up, and wagons ground them to pieces, making holes in the pavement, and giving water a chance to get into the foundation. The ties for these tracks were laid on the sub-grade, only enough gravel being used to level up. It appears that in order to make a good brick street where railway tracks are in it, the ties will need as good a foundation as the pavement, in order to obviate the above defect. Cities that are putting down brick pavement, and have electric railways, should give this subject some consideration, or they may regret it in the future.

F. W. Cerny.

Columbus, O., March 10, 1893.

MR. SCHUBERT AGAIN REPLIES TO MR. DELANO.

To the Editor of Paving and Municipal Engineering:

Sir—I ask again your indulgence, and request you to allot a space in the next issue of your valuable magazine for the following reply to Mr. Delano's letter.

Mr. Delano, in his last letter, does not prove the correctness of the proverbial politeness of the French people, at least he, himself, can not be counted in, when the question of politeness is considered.

He accuses me of repeating old calumnies and blunders, when all and every one of the malicious accusations and misrepresentations ever uttered in your columns, regarding the asphalt and asphalt pavement, originated directly from him.

Mr. Delano denies again that your Paris correspondent did receive information from him, while your correspondent in the February number of 1892 says himself, that he gives below the translation from Mr. L. Malo's book on asphalt, which contains the malicious attack on American asphalt. Mr. Malo and Delano are partners, and the same spiteful utterances as taken from Mr. Malo's publication came to our ears in 1886 and 1887, emanating directly from Mr. Delano. Is this not enough to prove that he instigated the underhanded attacks on American asphalt? Has he not, in his writings, confirmed all my statements, that he was at the bottom of all this unpleasant controversy?

Mr. Delano is to make a present to your Paris correspondent of his little book on asphalt, but this present can not atone for the injury he, Mr. Delano, has done to your correspondent. I hope that your correspondent will take time to study up asphalt and asphalt pavements more fully before he accepts Mr. Delano, unconditionally, as authority on asphalt. If he does so, he will find that "What Mr. Delano does not know about asphalt" will fill a big book, if he still holds to his claim that limestone impregnated with asphalt is asphalt, and that all other materials are simply pitch.

Your correspondent will find in Mr. Delano's last letter a partial acknowledgment that street car tracks are detrimental to asphalt pavements, because Mr. Delano says "One thing is, that four lines of rails in a roadway increases the maintenance thereof, there are ten joints instead of two." Of course the extra maintenance demanded by the Delano Company was large enough so that the authorities of Paris found it cheaper to put down stone and wood pavements, instead of asphalt, after the failure of the American company. I repeat again, that Mr. Delano's asphalt, abutting the American asphalt, would have been also considered a failure, had it been laid by the American company, for reasons given in my last letter: yet no rails were in that portion of Rue de Rivoli.

Mr. Delano gives, in his letter of December 19, 1892, the quantities of compressed asphalt laid, as follows:

Berlin, 1,000,000 square yards.
London, 600,000 square yards.
Paris, about 500,000 square yards,

and claims in his letter of February 15, 1893, that these figures are official. I will give below the official figures of 1892:

Berlin, 1,036,176 square yards.
London, 360,000 square yards.
Paris, 385,351 square yards.

There is considerable discrepancy between the official figures and Mr. Delano's, but all of Mr. Delano's utterances have to be taken with the same degree of allowance. He sees himself and his work in such a magnified condition that it is impossible for him to convey the correct meaning to others. Look at his last utterance: "My company, as originator of the compressed asphalt industry, supplies the workmen and tools, and continues to supply the rock."

Only one who knows the true condition of affairs can appreciate the enormity of these misrepresentations. In Berlin, only one firm is taking the rock asphalt from the Seyssel mines, and this firm can not get more than one-fifth of the total yearly quantity to be laid in that city, and has been for a large number of years independent of the Delano Company, as regards the tools and the workmen. I have not a doubt that the same condition exists in London.

Julius Schubert.

New York, March 21, 1893.

SELECTIONS FROM THE PRESS.

CONCRETE HIGHWAY BRIDGE IN GERMANY.

An interesting type of framed concrete arch built near Erbach, Wurtemberg, Germany, is described in the *Deutsche-Bauzeitung.* The span of the arch is 105 feet, with a rise of 13.1 feet. In order to prevent cracks in the structure, and to counteract any motion in the abutments, which were constructed in somewhat soft ground, thin asphalt plates were inserted into arch, two at each end, near the springing lines, and one in the apex. These asphalt plates had a thickness of ⅞ inch at the top, and 19-32 inch at the bottom and were made up of several layers. After the arch had settled 1.9 inches, these plates were compressed to a uniform thickness of ½ inch. When the roadway ballast had been filled in, the total settling of the arch amounted to 4.7 inches. The thickness of the arch at the apex is 19.7 inches, and at the springing line 27.5 inches. The bases of the abutments are 11.5 feet wide, and are 8.2 below low water mark. The strains upon the ends of the arch were partly taken up by smaller arches. The greatest admissible compressive strains in the structure amount to 66.14 pounds per square centimeter. The cement used showed a crushing strength of from 35.27 to 39.7 pounds after seven days, and from 48.5 to 52.9 pounds after twenty-eight days. The concrete used for the abutments was made up of one part cement, two parts of sand, six parts of gravel, and ½ part of limestone rock broken into pieces weighing from twenty-two to forty-four pounds each. The concrete for the springers and lower parts of the haunches of the arch was composed of one part cement, 1.25 parts of sand, and three parts of gravel. With the exception of the sand, of which only one part was used, the same proportions were retained for the part near the crown of the arch. The gravel used ranged between the sizes of a walnut and of an egg, and was carefully washed. The ramming of the concrete was done in layers 31.5 inches thick. The centering was left undisturbed for two months after the arch had been constructed.—*Engineering News.*

CAUSE OF STREET RAILWAY ACCIDENTS.

In street railway management, as in the operation of steam roads, it is largely the small details that must be watched to prevent accident. It is all in vain to maintain the most careful inspection of machinery and wheels of locomotive and train if the same care is not taken of switches and an hundred other places. The manager may equip his car with the most approved brakes and fenders, and yet overlook the steps over which every passenger must pass twice during every ride. The number of accidents occurring to passengers while boarding or leaving a car will undoubtedly outnumber those arising from all other causes combined. Hence to carefully make a study of step and hand rails is one which may well engage the time of the busiest superintendent. We have seen steps on street cars which the directors would consider a constant source of danger if built into a flight of stairs in their residence. Such roads are, of course, exceptions, nevertheless it can do no harm to watch your steps and determine as to whether or not you are as fully protected as may be.—*Street Railway Review.*

A NEW STORAGE BATTERY SYSTEM OF TRACTION.

Despite the somewhat discouraging results which have attended the introduction of various storage battery systems during the past few years, inventors have not ceased to work in this line, and there are now before the public several systems which claim and are worthy of attention. Perhaps the latest claimants to the invention of a practicable system of storage battery traction are Messrs. Soley & Perkins, of Frankford, Philadelphia, Pa.

It has been the aim of the inventors to take everything out of the hands of the motorman, except one simple switch for starting or stopping the motor, so that however careless he may be no disastrous effects can result. The motorman has perfect control of the car by means of two levers, one of which governs the speed, and the other manipulates an exceedingly powerful brake. The car is equipped with one 20 h. p. motor, which runs constantly, but which can be shut off when descending a grade. When ascending a hill the motorman has at command two trains of gearing, one giving a speed of from zero to four miles per hour, and the other from zero to twelve miles; both, however, retaining the feature of single reduction. It has been estimated by prominent authorities that it requires about 9.6 h. p. to move an ordinary sixteen foot car fully loaded and weighing 8,000 pounds up a six per cent. grade at the rate of four miles per hour. This means 35.8 amperes. Allowing sixty per cent. loss, it would take 57.2 amperes for the batteries to furnish. This is well within the limits of the secondary cell. The difficulties with previous storage battery systems has been, Messrs. Soley & Perkins claim, that in ascending heavy grades a discharge of 175 to 200 amperes has been required, which is an unreasonably heavy discharge and can only result in the heating, buckling and destroying of the plates and active material of the cell. This invention, however, is claimed to obviate all these difficulties, and to present a good solution of this difficult question.

The invention of Messrs. Soley & Perkins has been placed in the hands of several capitalists in Frankford, Philadelphia, Mr. James Wolstencroft, of Wolstencroft & Co., being president of the company, and Mr. William O'Neil, treasurer. A full sized model has been built, and active steps are being taken to push matters ahead as rapidly as possible.—*The Electrical World.*

MACHINERY AND TRADE.

IMPROVEMENTS IN A BRICK MACHINE.

It is comparatively only a few years since the ordinary type of an upright brick machine has been accepted as a success. A few years ago the horizontal tempering machine called a "pug-mill" was invented, and has been largely used as an auxiliary to the steam-power machine, and has proved its value in doing away with the soak-pit process. It is customary to attach these pug-mills to the brick machine, letting them deliver the clay directly into it.

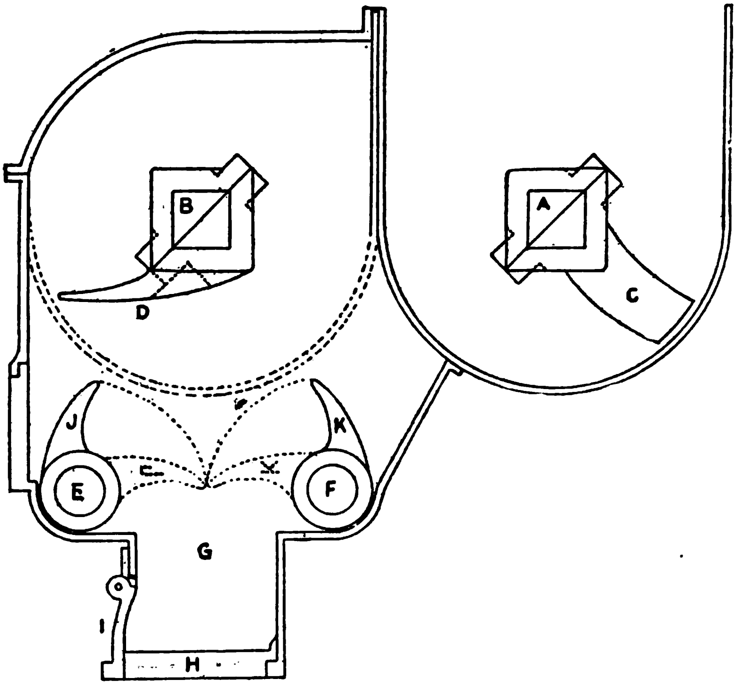


FIG. 1.

It was soon seen that these two machines could be combined into one single machine, which would be advantageous in many respects, and quite promptly several horizontal machines were invented and marketed, but the makers met new problems, which the other styles of machines had not brought to light, and these problems being too serious for them to solve satisfactorily, a large majority of the machines never got beyond the experimental stage.

The Wellington Machine Company were among the first to start an upright machine. They have developed it from a crude state until they now think they have one that is about perfect. The accompanying illustrations show two open-top pug-mills, each seven feet in length, placed side by side.

The clay is fed at the right-hand end of the rear one at the point marked C in the plan, and the tempering blades carry it in the direction of the arrow to the left-hand end of the pug-mill, where wipers take it through into the right-hand end of the front pug-mill at D, where seven wipers on this front shaft force it downward between the presses and into the press-box. The pressure is applied at the right moment, forcing the clay through a die of the usual pattern into the molds, which are ejected in the usual manner.

The presses consist of heavy wings, J and K, cast on four-inch round steel shafts E and F. Their movement is oscillating, having the motion of a quarter circle, as shown by the dotted lines. They stand open and facing each other while the wipers on the shaft B fill below and between them. The material is fed to the presses with ease and surety. The front tempering shaft is directly over and parallel with the presses, and runs three revolutions to each mold of brick. The blades on the left-hand portion of this shaft are given the proper pitch or bevel to keep that part of the pug-mill over the presses completely with the clay. Then directly over the presses the shaft carries seven wipers, D, which force the clay down between the presses.

When the pressure is put on by the operator at the front of the machine, the presses move, both at the same time, as shown by the dotted lines, to the lower position, also shown by the dotted lines. This forces the clay downward through the die, H, into the molds below. The presses remain in the lower position until the mold has been ejected, when they return promptly to the upper position, and there stand wide open until again filled.

In the first machine of the Wellington people the face of the press came within four inches of the die. The results were not satisfactory, and they studied to see what was wrong. They tried the next machine with the face of the press six inches from the die, and, getting better results, increased this distance in each succeeding machine until now, in the pressing chamber G, it is nearly fifteen inches from the die to the face of the presses when in their lowest position. This gives a large body of clay between the presses and the mold, and insures at all times *an absolutely even and perfect distribution and equality of pressure on each brick.* The deep press-box also avoids danger from trouble with large stones or other obstructions getting between presses and dies, that occasionally do get in machines through gross carelessness.

On the right hand end of the rear shaft is a disc, with steel wrist-pin carrying an arm reaching to a "bell crank," or loose arm supported at the end of the front press-shaft. The loose arm is given a reciprocating motion of a quarter circle. On the press shaft is rigidly attached a notched casting, the edge carrying the notches also being a quarter circle. The loose arm carries a "dog" pivoted at the rear end. The regulating handle at the front of the machine is connected with a casting, by means of which this dog is kept entirely out of the notches, or allowed to drop into any particular notch required. The regulating handle has a spring clutch, such as is commonly used on agricultural machinery, whereby the placing of this clutch in the notches of the casting by the side of it, engages the "dog" in the corresponding notches on the regulating arm. Right here are two little points that are of value, and contained in no other device. The regulating arm is always stationary, and the pressure can be changed at any part of the stroke of the press. In all others the regulating device is in motion, and the man in regulating the pressure has to follow its motion with his hand, and also watch the motion of the press to catch some particular moment when the pressure can be changed.

SAFETY DEVICES.

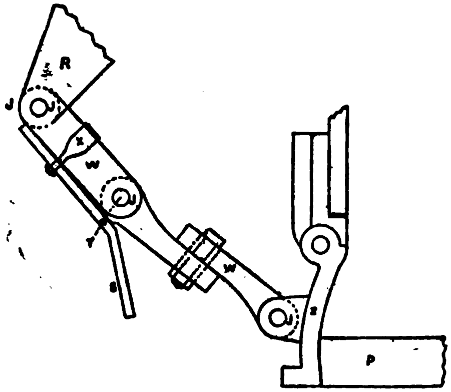


FIG. 2.

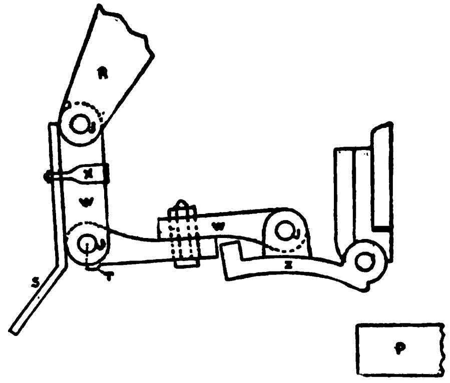
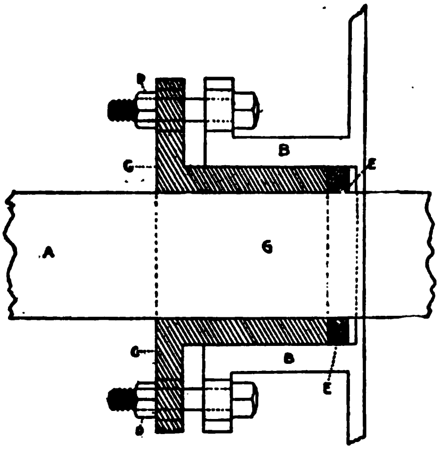


FIG. 3.

The stone relief door is a little gem of mechanical ingenuity and perfection. The toggle principle is used. In the figures 2 and 3, R is the lug to which the upper joint is hinged. W W are the arms making the toggle. J J J, the joints of the toggle. Z, the door. P shows a side view of the end of the die. S, the spring, and X, a movable clip regulating the tension of the spring, and T the small lug or projection on the lower arm of the toggle. When the door is shut as in Fig. 2 the door is rigidly held to place, but as the middle joint is set just a little outside of a straight line between the other two joints, any dangerous pressure will force the door open into the position as shown in Fig. 3. Whenever the operator wishes to open one or more of the doors he takes hold of the handle part of the spring, S, and pulls towards him, and a very slight pull on this will open the door, while a very heavy pressure on the door itself is required to open it. It will be noticed that the lower arm of the toggle consists of two pieces. These are slotted and held by a bolt, allowing the lengthening of this arm as the edge of the door wears off.



The above is a section showing the stuffing-box as used at the four places where the press shafts pass through the main heads. A is the shaft, B the head, C the stuffing-gland, D D the bolts for tightening, and E the packing. By use of this device the mud and water is perfectly and absolutety kept from the bearings and wearing surfaces. Also, again refer to the small plan drawing accompanying the large cut. This shows the location of bearings and stuffing-boxes for the pug-mill shafts. Note that the bearings, A, are located entirely outside the head, and the stuffing-box, B, is at the point where the shafts pass through the heads. They are simply regulated by the bolts on the outside of the head.

It is claimed that these machines will mold brick at the stiffest possible consistency that is practical, and fill them all perfectly square. The machines are made by the Wellington Machine Co., of Wellington, O., of which C. McDermott is secretary.

GOOD POINTS OF A STREET SWEEPER.

It is claimed for the Champion street sweepers that they will move from two to four inches of wet mud street accumulations into windrows with one team of horses to each machine; that they will clean street car tracks of snow three to six inches deep; that they will leave the streets cleaner than the most careful work done by hand, shovels and brooms, at one-tenth the cost of the latter; that they will sweep equally well on asphalted, blocked, cobblestoned, macadamized, and brick-paved streets; that one steel broom in constant use will wear from ten to fourteen weeks, and will outwear from ten to twenty of the usual rattan brooms; that in short the machines will save their cost, broom and all, in half the first year's use. The frame of the machine is of clear and thoroughly seasoned hard wood, which affords the advantage of making them much lighter, and more durable than can be done by using ordinary lumber and an iron frame. All the parts of both cast and wrought iron are faced wherever there is any friction. Some sweepers are so constructed that the bearings and journals of all the shaftings are always binding against one another, resulting in a continual wearing and breaking. In the "Champion" this difficulty is overcome by the introduction of a self-equalizing balance bar, which allows the sweeper, while at work, to adjust itself to any inequalities in the roadway, causing each bearing to do its own work. The most effectual point about the "Champion" machine is that the power used is secured "direct from the driving point," to the end of the brush, from which the most work is expected, without the intervention of any counter-shafts or the transmission of power. The gearing of some sweepers is underneath the platform, close to and in front of the broom, thereby exposing it to all the dust and dirt which is thrown up by the revolutions of the broom, causing a cutting away of the gear wheels and journals, also constant and unnecessary wear of the machinery to such an extent that, in constant use, it is necessary to renew the gearing about once a month. In the "Champion" the bearings and journals are properly boxed and covered—the only gearing about the machine being two small pinion gear wheels on the end of the shaft and practically behind the broom, and the bearings of these and the wheels themselves are covered, thus protecting them from all dirt and dust, and they will, consequently, wear longer and easier.

AN IMPROVED BRICK MACHINE.

The catalogue of the Decatur Leader Manufacturing Company, of Decatur, Illinois, for 1893, is out. In introducing it, the proprietors state that they have spared neither expense nor effort to bring their machinery up to the highest standard of excellence. They have made many improvements during the last year, which are shown in the cuts in their new catalogue. Special attention is direted to their largest and heaviest brick machine with automatic cutter, separator and sander, which they claim is complete in every detail and mammoth in weight and strength. They describe it thus:

"Among its many conveniences are friction clutch pulley, operated from any point, roller feeder in hopper, hinge and safety-pin at die end to avoid breakages, improved double end thrust bearings, either lubricating or dry dies, forged steel augur shaft five inches at largest diameter, all steel shafts, powerful gearing, ample bearings, perfect lubrication. The tempering knives are in pairs clamped on shaft and may be removed independent of the rest. Hard iron screw or augur carefully ground. Dies and attachments may be had for making side cut bricks, hollow blocks, such as fire-proofing, building blocks and drain tile. A machine of this size is usually rated at fifty to eighty thousand brick per day of ten hours. We prefer to underrate rather than overrate its capacity, believing it will not diminish the number of our sales and that our patrons will feel that our goods will come fully up to their expectations at all times and under favorable conditions greatly exceed them. We guarantee 35,000 brick per day of ten hours under ordinary conditions; with good clay, well prepared, 50,000 brick, and recommend fifty-horse power. The machine without cutting table occupies a floor space of six feet four inches by thirteen feet with automatic cutter six feet four inches by twenty-seven feet to off-bearing belt, which is twelve feet long unless extra length is ordered; with side cut die and board delivery table six feet four inches by twenty feet.

"The driving pulley is fifty-four inch diameter by twelve inch face, and should run about one hundred and fifty revolutions per minute. Height to top of hopper, fifty-two inches. Height over all, sixty-one inches. Estimated weight, 12,000 pounds. For paving, foundation, and sewer brick, a dry die is preferred, owing to the fact that it offers more resistance and compresses more clay into the brick than lubricating dies. For building and general purpose brick a lubricating die is preferred because the bricks are not so dense, require less power to operate the machine and dry and burn quicker."

Much information is given regarding the other clay-working machinery of this firm, together with illustrations.

NOTES.

Carroll, Vick & Co., Toronto, Ont., will erect a shale paving brick plant.

The Hocking Clay Manufacturing Company, Logan, Ohio, has just contracted with the Frey-Sheckler Company, for one of their double die steam-power repressing machines.

The Frey-Sheckler Company, Bucyrus, Ohio, have just closed a contract with T. M. Walker, of Des Moines, Iowa, for a complete plant of machinery, also dry house for the manufacture of paving brick. The outfit consists of the following: No. 1 Bucyrus Giant Brick Machine, with automatic cutting table; No. 5 double gear pug-mill, two nine-feet diameter all iron and steel dry pans, one hoisting drum, clay cars, elevators, tailing's crushers, dump cars, all transmitting machinery and a Bucyrus Steam Tunnel Drier of 50,000 daily capacity.

The H. Nichols Company, New Lexington, Ohio, has just contracted for a complete set of machinery from The Frey-Sheckler Company for a capacity of 50,000 brick daily. The outfit consists of one of their largest machines, compound crusher, pug mill, cutting tables, etc.

The Galesburg Brick and Terra Cotta Company, Galesburg, Ill., has just contracted with the Frey-Sheckler Company, of Bucyrus, Ohio, for one of their Bucyrus Steam Tunnel Driers, 90,000 daily capacity. This will be one of the largest steam tunnel driers in the west.

The Canton Brick Company, Canton, Ohio, has just purchased a complete outfit of machinery from the Frey-Sheckler Company, including a No. 1 Bucyrus Giant Brick Machine, Wellsville Side-cut Table, tailing's crusher and one double die steam-power repressing machine.

The relative economy of different street pavements depends, it is evident, upon the cost of maintaining the pavement in good order for a period of years, and not, as is too often assumed, on the first cost, or the life of the pavement. Some interesting figures bearing upon this subject will be found in the advertisement of the Warren-Scharf Asphalt Paving Company, in this issue.

The Frey-Sheckler Company has supplied the Canon Brick and Tile Manufacturing Company, Canon City, Colo., with one of their nine-feet diameter all iron and steel dry pans and No. 5 pug-mill.

The Frey-Sheckler Company, Bucyrus, Ohio, has recently sold a complete outfit of their machinery to the J. Switzer Pressed Brick Company, Blossburg, Mont., comprising a No. 2 Giant Brick Machine, Wellsville Cutting Table, one nine-feet diameter all iron and steel dry pan, No. 5 double gear pug-mill and one of their double die steam-power repressing machines.

The Frey-Sheckler Company has just sold a complete plant of machinery to J. Meeks, Briggs & Co., Superior, Neb., for their new paving brick plant to be erected at Table Rock, Neb. The outfit consists of one of their large Giant machines, automatic cutting table, two nine-feet diameter dry pans, No. 5 pug-mill, tailings crusher, screens, 100 horse-power engine and two 75 horse-power boilers.

. A movable earth and rock excavator, 300 feet long, having a cantilever arm projecting over the waste bank 120 feet, is being designed by Mr. Henry Goldmark, M. Am. Soc. C. E., of Chicago, for use on the drainage canal of the Sanitary District. It consists of a Howe truss span, supported by two towers, 40 feet high, placed on each side of the cut. Two cars of five yards capacity each will be raised and transported at a time. Its estimated capacity is 700 cubic yards per hour.

IMPROVEMENT AND CONTRACTING NEWS

PAVING.

The annual appropriation bill in Worcester, Mass., includes $100,000 for highways, $45,000 for streets, and $16,000 for parks.

City Engineer Doremus, of Salt Lake City, has mapped out a ten-mile boulevard. The report submitted by him to the council was referred back for an estimate of cost of construction.

B. R. Morton, city engineer of Newport, Ky., writes that bids were invited for brick streets and the construction of sewers, but a question having arisen as to the validity of the bonds proposed to be issued, the same were recalled until a test could be made.

A committee representing the select and common councils of Erie, Pa., has recently made a brick pavement investigating trip. The party visited Youngstown, Canton, Pittsburgh, Wheeling, Columbus and other cities where brick pavement has been adopted for use instead of stone or asphalt. The Erie gentlemen were surprised to learn that concrete foundations are not in use in the cities visited. Slag from gas-houses and broken stone are considered better than concrete.

The report of F. A. Dunham, city engineer of Dunkirk, N. Y., for the street work done during the last two years, shows the construction of 7,229 feet of sewers, from ten to fifteen inches in diameter, at a total cost of $8,745.59; the construction of 48,423 square yards of brick pavement, with concrete foundations, at a cost of $130,904; 7,433 square yards of brick pavement with broken stone foundation at a cost of $16,621.07, and 28,857 square yards Telford-macadam pavement at a cost of $47,686.36.

CONTEMPLATED WORK.

Arcola, Ill., is still talking of paving her streets.

Lewistown, Mont., is agitating the paving question.

There is talk of paving La Porte street, Plymouth, Ind.

Park Avenue West, Mansfield, Ohio, will probably be paved.

W. D. Riddell of Xenia, Ohio, reports an active discussion of the street paving question in that city.

Plans are being made for the paving and sewering of Main street, Clyde, O.

Yamhill street, Portland, Ore., will probably be paved with asphalt or bituminous rock.

Ninth and Fifteenth streets, Kansas City, Mo., will probably be paved with asphalt.

Wichita, Kan., is preparing to tear up her Jasperite pavements and lay asphalt in their place.

Monroe, Mich., has issued $25,000 worth of bonds to do paving with during the coming summer.

L. E. Browne, city engineer of Richmond, Ind., writes that considerable macadamizing of streets is to be done in that city during the summer.

The Indianapolis, Ind., board of public works has decided to make some experiments with granite paving on Georgia and South Meridian streets.

The city clerk of Warsaw, Ind., writes that the question of paving streets this season is being discussed, but nothing definite has been decided upon yet.

City Engineer Place, of Cortland, N. Y., writes that as soon as the sewerage question is disposed of the village will adopt some definite plan for street improvement.

Geo. T. Day, city clerk of Union City, Ind., writes that the street paving question is being agitated by the property-owners. Several streets will be graded and graveled this season.

An active discussion of the paving question is in progress in Des Moines, Ia. A number of streets are to be paved, and a selection of the kind of pavement to be used is yet to be made.

The appropriations already made by the council of Baltimore, Md., for street paving this year, amount to a little over $1,200,000; and additional appropriations to the amount of $1,000,000 for repaving, will probably be made.

Riverside avenue, from Monroe to Division street, Spokane, Wash., will probably be paved with granite blocks at an estimated cost of $70,000. Howard street, from Sprague to Main avenue, is to be paved. Work on other streets is contemplated.

H. H. Wagoner, city engineer of Huntington, Ind., reports that street improvements there may include the extension of Division street to First, the widening of First street, and the improvement of Jefferson and Lafontaine streets.

The amount of paving which will be done in Buffalo, N. Y., this year will slightly exceed that of last year, during which twenty-four miles of streets were paved, at a total expense of $1,268,310.52. The pavements are to be principally asphalt.

The Philadelphia Common Council has appropriated $400,000 for the purpose of repaving small streets with asphalt. This is an effective step in the direction of keeping the city clean and of lessening the danger of disease in the poor and populous districts.

From $12,000,000 to $15,000,000 will be spent for public works under the special assessment system in Chicago this year. The commissioner of public works has already let eight hundred contracts for street improvements, the aggregate cost of which will be about $3,000,000. Contracts involving a much larger amount are yet to be let. This will include asphalt, cedar block, macadam, and granite block pavements.

It is reported that plans are in preparation looking to the parking of Grant avenue, Denver, Colorado, throughout its entire length. The contemplated improvements include the construction of two macadamized driveways, each twenty-five feet wide. Between the driveways a space fifteen feet wide is to be set apart for a lawn, in the center of which a row of shade trees is to be planted. Trees will also be set on either sidewalk, so as to make the avenue one of the most attractive residence streets in Denver.

CONTRACTS TO BE LET.

Lima, Ohio, will pave the public square with brick.

Third street, St. Paul, Minn., is to be repaved this summer.

About twenty streets of Milwaukee, Wis., are to be paved with cedar blocks.

The Norwood, Ohio, council has voted to advertise for bids for improving three streets.

Parts of Glessner avenue, Park avenue and Bowman street, Mansfield, O., are to be paved.

West Main street, from the Ohio canal to the west line of Henry street, Massillon, O., will be paved.

The board of public works of Knoxville, Tenn., has been instructed to advertise for bids for brick paving.

The Ottawa, Ontario, Board of Public Works has voted to pave Rideau street with asphalt, at a cost of $70,000.

Ordinances have been passed for the grading, draining and improving of Paulin and Lydia streets, Youngstown, O.

A. B. Phillips, of Ashtabula, Ohio, writes that contracts for 10,000 square yards of brick paving will be let about May 1.

The city engineer of Albany, N. Y., is preparing estimates for paving in nine streets with granite blocks, and one with asphalt.

East Berry street, Ft. Wayne, Ind., from Barr to Monroe streets, a distance of about 1,200 feet, is to be paved with brick or asphalt.

The city clerk of Marshalltown, Ia., will receive bids until April 10 for 27,317 square yards of brick paving and 10,640 lineal feet of stone curbing.

Asphalt paving to cost about $45,000, has been ordered at Pasadena, Cal. The estimated cost of the paving is twenty-five cents per square foot.

Proposals will be received at the office of the commissioners, Washington, D. C., until April 13 for furnishing granite curbing and granite paving blocks.

The Milwaukee, Wis., Board of Public Works have a list of about twenty streets to be graded, curbed and paved this season. Stone curbing and cedar blocks will be used.

A new paving ordinance in Pekin, Ill., provides for the paving with brick of Court street from Front to Fifth; and Capitol and South Fourth streets, from Court to St. Mary's.

W. P. Butler, city engineer of Bloomington, Ill., writes that bids will be received in the near future for a brick street pavement five blocks long, about 5,200 square yards, and for about 2,700 lineal feet of stone curbing.

Resolutions have been passed by the city council of Canton, Ohio, for the improvement of North Market street by paving roadway with vitrified street paving brick on a broken stone foundation; also for brick paving on concrete foundation on Eighth street.

Bids will be received until April 14th, for curbing and paving in Ashville, N. C., requiring about 11,000 feet of curb, about 20,000 square yards of granite paving and about 14,000 square yards of macadam; also for curbing and paving with granite, or bricks, Haywood street from Patton avenue East to Patton avenue West, about 12,500 square yards of pavement and 5,500 feet of curb.

C. S. Rapp, city recorder of Ogden, Utah, writes that proposals will be let this month for paving Twenty-fifth street with Utah sandstone and asphaltum.

Resolutions have been passed providing for the granite curbing and bituminous rock paving of Grove street between Octavia and Laguna streets, in San Francisco.

City Engineer Morrison, of Tacoma, Wash., has submitted to the board of public works an estimate for the paving of Pacific avenue with bituminous rock, from Seventeenth to Twenty-fourth streets. The total cost is placed at $70,000.

Ordinances have been passed for vitrified brick paving in Louisville, Ky., on portions of Barrett, Avery, Camp, Floyd, Madison, Maple, Speckert and Twenty-second streets and for boulders on one block of Washington street. Ordinances for the improvement of various sidewalks and alleys were also passed.

T. L. McConnell, city book-keeper of Lexington, Ky., writes that the general council has accepted the plans and specifications of the surveyor for the reconstruction of the roadway of High street from Rose to Maxwell street, a distance of about one and one-half miles, with asphalt. The bids are now to be entertained.

Forty-nine streets or portions of streets in Cleveland, Ohio, will be repaved this season, making a total of over sixteen miles, at a cost of $1,198,100. Most of this paving will be done with dressed block stone, while brick and common Medina block will be used for a large percentage. Four streets will be paved with asphalt.

Twelve miles of street paving will be laid in Dayton, Ohio, during 1893. The work on some of the streets to be improved will be let early in April and the other streets will follow in rapid succession as ordinances can be passed and published and the necessary advertising for proposals be completed. The board of city affairs will authorize paving this year amounting to about $800,000. There is much discussion and diversity of opinion as to the material to be used.

The property owners on East Burnside street, Portland, Ore., will put down a plank roadway. The planks are to be sawed so that they are three inches thick at the curb and five inches at the other end, making the roadway five inches thick in the middle. It is said that planking laid in this way will last four or five years in good condition, and by the time it is worn out, all pipes and sewer conduits will be laid and the property owners can proceed to improve the street in some substantial manner.

Streets ordered paved in Burlington, Iowa, include North Eighth, South Tenth, Smith and North streets, and Central avenue. The city council has appropriated $10,000 for street paving this year.

CONTRACTS AWARDED.

McIntyre & Wickham have the contract for paving Blake street, Denver, Colo.

The Acme Paving Co., of Indianapolis, has been awarded the contract to pave Jefferson street, Franklin, Ind.

Henry Vogel, of Helena, Mont., has secured the contract for paving with brick, Central avenue in Great Falls, Mont.

J. H. Bain, of Goldsboro, N. C., writes that a contract has been made for 2,000 tons of shell rock for street paving purposes.

The contract for the Fulton street pavement, Toledo, O., has been let to the Warren-Scharf Asphalt Paving Company for $377,54.88.

E. L. House has been engaged to make estimates and do the engineering work on the State street paving, Painesville, Ohio, for a consideration of $500.

C. F. Lane writes that Herring & Straub, of Mansfield, Ohio, have been awarded the contract for brick paving in Berea, Ohio. There were sixteen bidders.

The Winona Construction Co. have secured a contract for paving thirty-seven blocks of business streets in Winona for $118,430. Galesburg brick will be used.

L. E. Chapin, city engineer of Canton, Ohio, writes that McKinney & McNichols have the contract for grading Cedar street, 23,300 cubic yards, at 19 cents per cubic yard.

Jacobs & Stewart, of Norwalk, O., have secured the contract for the paving of Market street, Sandusky. Their bid ranged from $7,435 to $9,266, according to the style of paving.

J. W. James, of Sioux Falls, S. Dakota, writes that about one mile of two-inch pine six-foot sidewalk, has been contracted for at from thirty-three to thirty-five and one-half cents per lineal foot, and 600 feet of twelve-foot walk, at sixty-eight cents per lineal foot.

F. M. Shangle, city clerk of Oskaloosa, Iowa, writes that a contract for five blocks of street paving has been let to N. S. Young. The prices were as follows: Brick paving, including grading eleven inches, $1.65 per square yard; cement curb, fifty-six cents per lineal foot; reset cement curb, twenty cents per foot; brick curb, twenty-five cents per foot; excess grade, thirty cents per cubic yard.

Austin Ford & Son, Cambridge, Mass., have the contract for 2,500 feet of North River flagging at 37½ cents per square foot, delivered on the streets. The other bids were the New England Stone Co., Cambridge, 43 cents per square foot, and J. J. Cuddihy & Co., Boston, 41 cents per square foot.

Fred Hohmann, village clerk of Blue Island, Ill., reports that the contract for curbing and paving Western avenue, from Stony creek to Burr Oak avenue, was let to John V. McAdams at 80 cents per lineal foot for 5-inch limestone curbing and $1.17 per square yard for 8-inch cedar block pavement.

The following contracts have been awarded in San Francisco: For grading and macadamizing Iowa street from Yolo to Nevada, James McCoy, $4,000; for paving with bitumen the crossing of Fair Oaks and Twenty-second, City Street Improvement Company, $732; also, the crossing of Gough and Myrtle avenue, $570; stone sidewalks on Fulton from Broderick to Baker, Flinn and Treacy, $350.

Henry Kelling, city clerk of Walla Walla, Wash., writes that L. R. Hawley has been awarded the contract for improving Dr. Newell street, from Howard to Catharine, for $1,850 and surplus earth. The work calls for 3,124 cubic yards excavation, 1,171 cubic yards embankment, 3,196 lineal feet sidewalk six feet wide, 92 lineal feet sidewalk twelve feet wide, 3,384 lineal feet curbing, 112 lineal feet drain boxes, 1,753 lineal feet strawing fifty-six feet wide.

The following contracts for paving have been awarded in Kansas City, Mo.: Charlotte street, from Fifth to Sixteenth, Barber Asphalt Co., $2.50 per square yard; Eighteenth, from Grand to Main, with Diamond vitrified brick, F. P. McCormick, $1.93 per square yard; Holly, from Seventeenth to Eighteenth, Barber Asphalt Co., $2.50 per square yard; Third, from Grand to Wyandotte, with Diamond vitrified brick, F. G. Trestrail, $1.39¾ per square yard.

George H. Fister, city clerk of Elkhart, Ind., writes that the council has awarded the contracts for paving Jackson street, Second street, and Tyler avenue, Harrison, Marion, Franklin, High and Pigeon streets, between Main and Second streets, to A. F. Nims of that city. The bid for paving Jackson street with Canton Malvern fire clay brick on a crushed stone foundation, the interstices between the brick to be filled with Portland cement, was as follows: Vitrified brick pavement complete, $1.59 per square yard; curbing set complete, forty-three cents per lineal foot; filling, five cents per cubic yard; excavating, twenty-three cents per cubic yard. The pavement on the other streets is to be the same, with the exception of a gravel instead of crushed stone foundation, and will cost $1.37 per square yard.

Contracts for brick paving in Evansville, Ind., have been awarded as follows: Minnehaha Granite. Co., Indianapolis, Washington avenue, from Parrett to Garvin streets, $1.75 per square yard; Fifth street, from Sycamore to Pennsylvania streets, $1.70 per square yard; Second street, from Bayless to Emmett streets, $1.67 per square yard. James Nugent, Division street, from Second to Third streets, $1.66 per square yard, and Ingle street, from Water to First avenue, $1.67 per square yard.

E. H. Reed, superintendent of streets, of Cambridge, Mass., writes that Austin Ford & Son have secured the contract for 15,000 feet edgestone. The bidders were: F. J. Fuller, Quincy, straight, 53 cents per foot; circle, $1 per foot. Jeremiah McCarthy, Somerville, straight, 48½ cents; circle, 74 cents. Wight & Scorgie, Cambridge, straight, 50 cents; circle, 78 cents. S. & R. J. Lombard, Charlestown, straight, 48 cents; circle 73 cents. Austin Ford & Son, Cambridge, straight, 46 cents: circle, 75 cents.

SEWERAGE.

Deering, Me., is in great need of a better public sewerage system.

The citizens of Alexandria, Va., are agitating the sewerage question.

The question of surburban sewerage drainage is agitating the citizens of Memphis, Tenn., suburbs.

The sewage at Los Angeles, Cal., will be emptied into the ocean by means of a main sewer seventeen miles long.

Marsden Manson and C. E. Grunsky are the engineers engaged in devising a sewer system for East Oakland, Cal.

E. L. House has been engaged by the council of Painesville, O., to make estimates and do the engineering work on the Erie-street sewer for $250.

Donald McLeod, who has the contract for building the Washington street and Alabama street main sewers in Indianapolis, has begun work on the Alabama street sewer.

Three ordinances have been compiled by City Attorney Williams, of Denver, Colo., for the construction of the sewer approved by the board of aldermen. For the North Denver sewer No. 2 the estimated cost is $112,000, for the South Denver sewer, $126,000, and the short sewer connecting the latter with the Capital Hill sewer, $3,500.

Williams & Ulrich, of Springfield, O., are building a large trunk sewer at Richmond. It is heavy rock work, the deepest cut being 33½ feet. The work will be completed by the first of May.

The largest cement sewers made in the United States, of which there is any record, were made in Galveston, Tex., for the Twentieth street sewer. These are forty-two inches bore, three feet long, and weigh about 2,000 pounds each section.

CONTEMPLATED WORK.

Huntsville, Tenn., is discussing the sewerage question.

Cairo, Ohio, proposes to put in a system of sewers this season.

Alliance, Ohio, voted four to one in favor of extending the sewerage system.

Auburn, Cal., is considering the investment of $20,000 on a sewerage system.

The ordinance has been passed for building a sewer in Walnut street, Peoria, Ill.

The Maquoketa, Iowa, city council is considering the establishment of a sewerage system.

The question of sewerage and other public improvements is being introduced at Lockland, Ohio.

The Salt Lake City, Utah, council has appropriated $300,000 for the proposed gravity sewer system.

L. E. Browne, of Richmond, Ind., reports that some sewer work will be done in that city during the summer.

Colonel Delafield, of New York has charge of a force surveying for a new sewerage system for Palestine, Texas.

The movement for a system of sewers in Rome, N. Y., has taken form and the adoption of the plans will be voted upon by the tax-payers.

Menasha, Wis., thinks of building a sewer a mile long, to empty into Lake Winnebago. The cost of the proposed work is estimated at $12,000.

North Andover, Mass., has accepted the report of the Committee on Sewerage recommending the adoption of a system to cost about $44,000.

Plans have been prepared at Newark, N. J., for sewers estimated to cost about $175,000. The city surveyor recommends that a part to cost $108,000 be constructed as soon as possible.

Frank Place, city engineer of Cortland, N. Y., writes that the sewer commissioners will submit to popular vote a proposition for the construction of a system of sanitary sewers in that village.

J. Wesley Wright, clerk of Bristol, Pa., writes that efforts are being made to have the state legislature repeal the debt-limiting clause of the Boro Charter, so as to erect a public sewer at a cost of about $50,000.

T. H. Bain, of Goldsboro, N. C., writes that a vote will probably be taken about the first of May, on the question of issuing bonds to the amount of $50,000 for a system of sewerage and other public improvements.

Frederick P. Stearns, chief engineer of the Massachusetts Board of Health, has been requested by the West Side sewer commissioners of Rochester, N. Y., to revise the plans for the proposed sewer on the west side of the river.

An order was passed by the board of aldermen of Brockton, Mass., authorizing a loan of $285,000 to be used in the construction of the sewerage system. The common council concurred with the board of aldermen in authorizing the sewerage loan.

City Surveyor Adams has submitted two sewerage plans for the eastern part of the city wards at Newark, N. J. One plan is to run a main sewer from the intercepting sewer at Avenue I, through Avenue I, Jabez street, Berlin street, Manufacturers' lane, Ferry street to the Plank road, to Lockwood street. The fall will be 8½ feet. The other plan provides for a main sewer from Horatio street to Freeman street and Passaic avenue.

Plans and specifications have been prepared by the city engineer of Indianapolis for the Mississippi street trunk sewer, from Merrill street to St. Clair; thence to Meridian, thence to the first alley north of St. Joseph street, thence east to Delaware street, thence north to Home avenue, thence east to Central avenue, thence north to Seventh street. Length 14,466 feet; sizes eight feet to twelve inches circular.

CONTRACTS AWARDED.

Contracts have been awarded for a general system of sewers at Modesto, Cal.

Red Jacket, Mich., has let the contract for a sewer system to cost in the neighborhood of $130,000.

Frank L. Allen, of Worcester, Mass., has the contract for building eight miles of sewers for the town of Bennington, Vt.

Twenty-two thousand four hundred and twenty-one dollars worth of new sewers has been contracted for at Monmouth, Ill.

Contracts have been awarded at St. Paul, Minn., to P. Doherty for a sewer on Grand avenue; Hansen & Johnson, on Milton street and Hague avenue; Patrick Thornton, on University street between Grotto and St. Albans street.

CONTRACTS TO BE LET.

The Philadelphia city council has voted to construct sewers in thirty-two streets.

W. H. Caldwell, of New Britain, Conn., has prepared plans for a sewerage system for Plainville, Conn.

A. B. Phillips, clerk of Ashtabula, Ohio, writes that sewer contracts for two streets will be let about April 20.

Sioux Falls, S. D., is about to let the contract for constructing thirteen miles of sewerage, at a total cost of $325,000.

L. W. Fogg, engineer for Latrobe, Pa., writes that several large sewers will be built this year. Plans have been adopted.

W. J. Miller, city clerk of Ann Arbor, Mich., reports that the city has voted to issue bonds for $30,000 for the construction of a main sewer.

Le Mars, Ia., is considering plans for about twelve miles of sewers, estimated to cost $73,000. It is intended to commence the construction this spring.

Bids will be received by W. Ellwood Wynne, of Avondale, Hamilton county, O., until April 14, 1893, for the construction of sewers in Shillito street, Beach street, Borrman avenue, Savoy Place and Bowman avenue in District No. 2.

W. P. Butler, city engineer of Bloomington, Ill., writes that bids will soon be wanted for a 12-inch vitrified pipe sewer 250 feet long, and a 15-inch vitrified pipe sewer 750 feet long.

Sealed proposals will be received at Dayton, O., until April 10, for furnishing materials and constructing storm sewers and appurtenances. The work on which bids are solicited comprises about 2,632 lineal feet of sewer 6 ft. 8 in. x 8 ft.; 665 lineal feet of 6 ft. 1 in. x 7 ft. 3 in.; 1,335 lineal feet of 5 ft. 8 in. x 6 ft. 9 in.; 375 lineal feet of 5 ft.; 1,200 lineal feet of 4 ft. 6 in.

Bids will be received by the board of city affairs, until April 10, for the construction of storm sewers in the city of Dayton, O. There will be required about 6,207 lineal feet of sewers; 4,250 cubic yards of brick masonry; 1,300 cubic yards of stone masonry; 1,200 cubic yards of concrete masonry; 7,750 cubic yards excavation; 15,000 cubic yards backfilling; 20,000 feet of lumber; five tons of iron pipe, and other minor items.

WATER-WORKS.

The citizens of New Orleans, La., will soon have filtered water flowing through the mains. The plant is almost completed, and is one of the largest in the country.

Ten thousand feet of six-inch pipe and smaller quantities of four, eight, and ten-inch mains will be added to the water-works system at Holyoke, Mass.

The latest scheme of the authorities of Hamburg, Germany, to purify the town water supply is to erect machinery for the heating of the water in pipes to the boiling point before allowing it to pass along the distributing mains for consumption by the people. Both typhoid fever and cholera bacilli are killed before even this temperature is attained, and, by the adoption of this method, it is expected that the risks of either disease would be reduced to a minimum.

CONTEMPLATED WORK.

Water-works are talked of at Hubbard and Lockland, O.

Frankfort, Mich., is discussing the water-works question.

Sturgeon Bay and Waupaca, Wis., propose building water-works.

Fairport, N. Y., citizens have voted in favor of establishing municipal water-works.

About 1,300 feet of water main will be constructed on West Division street, Union City, Ind.

The people of Springfield, O., will make an addition to the equipment of the city water-works that will cost $125,000.

The water-works question is agitated at Milton, Ohio, Doylestown, Ohio, Frostburg, Md., Garfield, Wash., Buffalo, Wyo., Harriman, Tenn., Washington, Kan., Waupaca, Wis., Fowler, Ind., Doon, Ia., Centerville, Ia., Cascade, Ia., Grundy Center, Ia., Silver Plume, Colo., and Jacksonville, Texas.

M. M. Moore, clerk of the Columbus, Ga., council, reports that the council has appointed a committee to investigate as to the cost of water supply for the northern portion of the city. This may necessitate additional works, as the system now in use is on the gravity plan, and at present the pressure is not great enough to answer the purpose.

CONTRACTS AWARDED.

Moweaqua, Ill., has contracted for a system of water-works.

Greenfield, Ind., has contracted for a water-works plant to cost $40,000.

The contract has been awarded for water-works at Atlantic Highlands, N. J.

R. W. Havens, city engineer of Dallas, Tex., writes that the city has let the contract for twelve car loads of water-pipe to the Howard Harrison Iron Co., of Bessemer, Ala.

C. B. Talbot has agreed to furnish Tacoma, Wash., with a supply of 20,000,000 gallons a day pure mountain water for $852,500.

About two miles of water mains will be added to the water-works at Marion, Ind., John Cameron has the contract for doing the work.

The contract has been let to construct the extension of the city water-works system at Fairbury, Ill. Chas. T. Tobin, of Hillsboro, was awarded the contract.

The city council of Portland, Ore., has let contracts for the construction of a steel pipe line to carry water from Bull Run to Portland, a distance of thirty miles. The contract for supplying 11,442,000 pounds of steel plate was let to the Risdon Iron Works of San Francisco. The contract for cast-iron pipes was awarded to the Oregon Iron and Steel Company. The construction of headworks and bridges and the manufacturing and laying of steel pipes were let to local bidders, the whole amounting to $1,000,000.

WATER-WORKS CONTRACTS TO BE LET.

Topton, Pa., has voted in favor of water-works.

Barnesville, Ga., citizens have voted in favor of a water-works system.

Thomas Burress, Jr., city recorder of Jonesboro, Ark., writes that that city wishes to grant a franchise for water-works.

During the present year, the Cedar Rapids, Iowa, Water Company will expend $15,000 in pipes for the extension of mains.

Water-works will be built at Greenville, Darke county, O.; Norwood, O.; Fullerton, Neb.; Demopolis, Ala., and Martinsville, Va.

W. P. Butler, city engineer of Bloomington, Ill., writes that bids will be wanted in the near future for 1,700 feet of six-inch water main.

The town board of Cicero, Ill., has passed an ordinance providing for laying water pipes in Berwyn and La Vergne, which will cost about $57,600.

J. P. Wellman, city clerk of Keene, N. H., writes the city will soon receive bids for the furnishing of about one mile of twelve-inch iron water pipe, with the necessary Ts, gates and hydrants.

Sealed proposals will be received by Andrew G. Ankenbauer, clerk of the board of water-works and electric light trustees of the village of Reading, Ohio, until April 12, 1893, for three hundred tons of coated cast iron pipe 3, 4, 6, 8 and 10 inches internal diameter, six tons of specials, 50 fire hydrants, single nozzle valves; 11 8-inch, 7 6 inch, 9 4-inch, 9 3-inch, with stop boxes. Also proposals for trenching, laying and back-filling of the above pipe, and for setting hydrants, specials, valves and valve boxes.

New water mains will be added to the water-works system of Milwaukee, Wis.; pipes will be laid on the following streets: Chambers, from Fifth to Sixth; Holton, from Wright to Clarke; Ninth, from Chambers to Locust; Sixth avenue, from Maple to Windlake avenue; Bishop avenue, from Potter avenue to Superior; Lenox, from Homer to Deer; Lenox, from Kinnickinnic avenue to Russell avenue; Grove, from Rogers to Lincoln avenue; Twenty-second, from Fond du Lac avenue to Wright; Wilcox, from South Bay to the right-of-way of the North-Western Railroad in the Twelth Ward; Lee, from Ninth to Tenth; Park Hill avenue, from Thirty-first to Thirty-second; Murray avenue, from Park Place to Folsom Place.

BRIDGES.

Montrose county, Colo., is at present building three new bridges.

The Pacific Short Line is completing a new $1,000,000 bridge at Sioux City, Iowa.

Dayton, O., wants a new wrought-iron bridge to span Wolf creek at Broadway street.

A pontoon bridge over the Mississippi river at Burlington, Ia., is being agitated by the *Hawkeye.*

The question of building a bridge across the river at the foot of Post street, Spokane, Wash., is being agitated.

Plans have been drawn for a bridge across the Mississippi at Red Wing, Minn. The stucture will cost $70,000.

The project of building a bridge across Portage lake, between Houghton and Hancock, Mich., is again being agitated.

A bill has been introduced in congress authorizing the construction of another bridge across the river at St. Louis, Mo.

The bill bonding Cuyahoga county, Ohio, $160,000 for the purpose of building the new Brooklyn-Brighton bridge, has become a law.

A new $20,000 bridge is wanted at West Court street, Kankakee, Ill., and an effort is being made to secure the amount by subscription.

A committee of business men and taxpayers, of Dubuque, Iowa, are asking the council to construct a draw-bridge across the mouth of the ice harbor to connect with the roadway to the high bridge along the old levee. They claim that it is a better means of getting a new approach to the bridge than by extending Fourth street, which will cost $100,000 and the cost of the draw-bridge is estimated at $15,000.

Coon River at Eighteenth and Grand avenues, Des Moines, Ia., will be spanned by a new bridge. The approach or apron will be 248 feet long while the bridge proper will be 738 feet long.

A new bridge will be constructed across the gorge at Niagara Falls either by the Railway Suspension Bridge Company or the Grand Trunk Railway Company. The proposition of the bridge company is to construct a double-track bridge lower down the gorge, with a roadway for electric cars and carriages, besides footpaths for pedestrians.

Perhaps the most remarkable electric street railway bridge in the country, its roadway being 155 feet high and 850 feet long, or twenty feet higher than the roadway of the Brooklyn bridge, was formally opened by moonlight at Pittsburgh last night. It spans Jack's run, and lets the Pleasant Valley electric street cars from Pittsburgh and Alleghany into Bellevue and Avalon, and later to Sewickly, along the hills and banks of the Ohio river.

The board of supervisors of Sonoma county, Cal., will receive bids until May 4th, 1893, for the construction of a wagon bridge across Russian river near the city of Healdsburg, together with plans, specifications, working details and strain sheets, bridge to be 400 feet in length, of two or three spans, and 18 feet roadway. Bids will be considered for both a steel and iron bridge and a combination truss bridge.

R. B. Dennis, city clerk of Des Moines, Iowa, writes that the following bids for bridges have been received by the board of public works: A. M. Raum, $66,000; St. Louis Bridge Company, $65,980; Fair, Williams & Co., $64,775; Missouri Valley Bridge Company, $63,500; Kansas City Bridge Company, $62,578; R. D. Wharton & Co., $61,000; Canton Bridge Company, $59,600; Wisconsin Bridge Company, $59,380; Youngstown Bridge Company, $58,700; Variety Iron Works, $57,700; Wrought Iron Bridge Company, $56,996; St. Joseph Iron Bridge Company, $55,300; Toledo Iron Bridge Company, $54,873; Massillon Bridge Company, $49,990; George E. King Bridge Company, $48,970; King Bridge and Manufacturing Company, $48,000.

STREET LIGHTING.

Algona, Ia., is discussing the question of electric lights.

Huntington Valley, Pa., is discussing the electric light question.

Frankfort, Mich., is agitating the question of operating an electric light plant.

The question of street lighting by electricity is being discussed at Bradford, Pa.

The DePere, Wis., council has granted a franchise to an electric light company for a period of ten years.

The clerk of Newark, Ohio, has been instructed to advertise for bids for the construction of an electric light plant.

The citizens of the southeast district of Portland, Ore., recently taken into the city by the new charter, are discussing the electric street lighting question.

W. H. Wilmot, city clerk of Lambertville, N. J., writes that the Lambertville Electric Light, Heat and Power Co. are preparing to erect a plant at an early date.

Electric plants for street lighting purposes are to be erected at Caldwell, Ohio, Carrollton, Ind., Charlevoix, Mich., Fargo, N. D., Lancaster, N. H., Manchester, Conn., Newark, Ohio, and Warrensburg, N. Y.

Geo. H. Fister, city clerk of Elkhart, Ind., writes that on April 5 proposals will be received for fifty or more electric lights to burn all night and every night. Lights are to be located over the center of the street, not less than thirty feet high and at every alternate square.

S. H. Finley, city engineer of Santa Ana, Cal., writes that the water-works erected by that city two years ago has proved such a grand success that the board of trustees are contemplating putting in an electric light plant in connection with it, and will probably, in the near future, advertise for bids for that purpose.

A street-lighting ordinance in Omaha, Neb., provides for the placing of forty-four 2,000 candle power arc lights at that many railway and street intersections. The ordinance provides that the different railway companies shall pay for the rental for all lights placed at the intersections along their respective lines.

H. M. Miles, of Michigan City, Ind., writes that the Lake City's Electric Railway Co. has been awarded the contract to light the city and will construct a combination plant. The contract for the same has been let to the General Electric Co., of Chicago, for $225,000. The contract price per lamp for lighting the city is $75 per year for lamps burning until midnight, and for each hour after midnight 50 cents per lamp per month. Arc lamps per month, $8.

PUBLIC PARKS.

The old cemetery site, Laporte, Ind., will be transformed into a city park.

Seattle, Wash., is to have a public park on the shore of Lake Washington.

The city of Great Falls, Mont., has at its disposal $40,000 for the purchase of parks.

A new park bill provides for the division of Kansas City into two or more park districts and the establishment of one park in each district. The cost of the parks shall be paid by special assessments on the property in the respective districts.

The city council of Uvalde, Texas, has passed an ordinance directing that Fountain plaza be planted with trees and grass and that a fountain be erected thereon. Provision has also been made for the maintenance of such improvements.

The park board of St. Paul, Minn., has appropriated $2,030 for the purchase of the Minnetonka dredge and $6,000 for dredging Powder Horn Lake. The report of the finance committee showed estimated receipts of $255,355 for the coming year. Of this amount $52,418 is reserved for improvements, distributed equitably among the different parks. Loring Park will get $7,000; the Kenwood parkway, $3,500; Lake of the Isles, $3,000; Minnehaha Park, $3,000, and $2,500 will be expended for boats at Lake Harriet.

STREET RAILWAYS.

R. W. Havens, of Dallas, Texas, writes that the Electric Railway Co. has begun work and expect to have the road completed by July 31.

The Kalamazoo (Mich.) Electric Co. will furnish the power for the street railway company. Four one hundred horse power generators will be put in.

U. G. Scheffler, of Pen Argyl, Pa., writes that there is a movement on foot to build an electric railway from the Delaware Water Gap to Pen Argyl. Address for information, G. B. Reum, Sunbury, Pa.

A new ordinance in Covington, Ky., compels the street car company to have each car provided with a jack-screw. The ordinance imposes a penalty of not less than $50 for any car not supplied with the hydraulic lifter.

J. C. Kuhlman, city clerk of Wausau, Wis., writes that the city council has granted a franchise for an electric street railway to Messrs. B. E. Jones, Walt. Alexander, H. Dunfield and J. D. Ross. The line of road is to be about four miles long and work thereon must be commenced on or before June 1, 1893, and must be completed within eighteen months from the date of the franchise.

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SEALED PROPOSALS.

STREET IMPROVEMENT.

Sealed proposals will be received by the city of Bucyrus, O., at the office of the City Civil Engineer of the city of Bucyrus, O., until 12 o,clock noon, of Tuesday, April 18, A. D. 1893, for the improvement of Walnut street from the north line of Perry street south to south line of Lucas street. And for the improvement of North Sandusky avenue from the south line of outlot 24a north to the corporation line, according to the specifications on file in the office of the City Civil Engineer of said city. The bids may be for either work or material, or both; if for both, each bid must be separately stated with the price. The board reserves the right of rejecting any or all of the bids. Each bid to be guaranteed according to law. Bidders must use the printed forms which will be furnished on application to the City Civil Engineer, and in all respects must comply with the rules accompanying said printed forms. By order of the City Council.

W. A. BLICKE, City Clerk.

Bucyrus, O., March 9, 1893.

GRADING AND PAVING.

In pursuance of a resolution of the Common Council of the City of Richmond, Indiana, the Board of Public Improvements will receive sealed proposals at the office of the City Clerk until 2 o'clock P. M., Friday, April 14th. 1893, for grading and paving with vitrified brick or block Main street from Fourth to Sixth and from Ninth to Eleventh streets, and the construction of new stone curbing between said terminal points, in accordance with the plans and specifications of the City Civil Engineer.

All blanks and information furnished by the City Engineer on application. The Board reserves the right to reject any or all bids.

CHAS. G. SWAIN, City Clerk.

CONSTRUCTION OF SEWERS.

Sealed proposals will be received by the undersigned at his office in the Town Hall, Avondale, Hamilton county, Ohio, until 12 o'clock M. of Friday, April 14, 1893, for the construction of sewers in Shillito street, Beech street, Borrman avenue, Savoy Place and Bowman avenue, in District No. 2, in accordance with plans and specifications on file in the office of the Village Engineer, Town Hall, Avondale.

The Village Council reserves the right to reject any or all bids. Printed forms to be used.

W. ELLWOOD WYNNE, Corporation Clerk.

Avondale, March 14, 1893.

CURBING AND PAVING BLOCKS.

OFFICE OF THE COMMISSIONERS, D. C.
WASHINGTON, D. C., March, 13, 1893.

Sealed proposals will be received at this office until 12 o'clock M., April 13, 1893, for furnishing granite curbing and granite paving blocks. Blank forms of proposals and specifications, together with all necessary information, may be obtained at this office.

J. W. ROSS,
M. M. PARKER,
Commissioners, D. C.

SEALED PROPOSALS.

STREET PAVING WITH BRICK

AT MATTOON, ILL.

Sealed proposals for bids will be received at the City Clerk's office until 7 P. M. of the 21st day of April, 1893, for paving with brick and furnishing all material for the same under the provisions of "An Ordinance for the Improvement of Charleston street, from West First street to Ninth street," covering a length of 3,694 feet, and width of forty (40) feet of surface; also for the same purpose to cover a total amount of 40,018 square yards under the provisions of five other ordinances. Copies of said ordinances, specifications and all other information will be furnished on application to the City Clerk. A certified check of $500 (draft or cash), must accompany bids under each ordinance. The city reserves the right to reject any and all bids.

Dated March 21, 1893.

CHAS. HOGUE, City Clerk.
FRANK KERN, Mayor.

READING (O.) WATER-WORKS.

Sealed proposals will be received at the office of Andrew G. Ankenbauer, clerk of the Board of Water-works and Electric Light Trustees of the village of Reading, Hamilton county, O., until 12 o'clock noon, Wednesday, April 12, 1893, for the following, approximstely: Three hundred (300) tons of coated cast iron pipe, 3, 4, 6. 8 and 10 inches internal diameter, f. o. b. Penn. R. R., Reading, O., or Big Four R. R., at East Lockland, O., on flat cars only; about 6 tons of specials, about 50 fire hydrants, single-nozzle valves; 11 8-inch, 7 6-inch, 9 4-inch, 9 3-inch, with stop boxes. Also proposals for trenching, laying and back-filling of the above pipe, and for setting hydrants, specials, valves and valve boxes. Proposals to be made on blank forms, furnished on application by the Trustees. Specifications can be seen or had at the Clerk's office. The Board reserves the right to reject any or all bids.

By order of the Trustees.

ANDREW G. ANKENBAUER, Clerk.

STREET IMPROVEMENTS.

Sealed proposals will be received at the office of the City Comptroller of the City of Dayton, until 12 o'clock noon, Monday, April 10, 1893, for improving Brown street, from Fifth street to alley south of Buckeye street; Brown street, from alley south of Buckeye street to Oak street; Brown street, from Oak street to Fairground ave.; Bridge street, from Monument avenue to First street; Kenton street, from Third street to Fourth street; Fourth street, from Jefferson street to basin extension canal, by constructing necessary foundations, and making necessary excavation for same, furnishing and paving the roadway with Medina block, Hayden block, Hallwood block, asphalt, red brick or fire brick, furnishing and setting new curbs, constructing the necessary culverts, drains, catch-basins and retaining walls, in accordance with the plans and specifications on file in the office of the City Civil Engineer.

The Board reserves the right to reject any or all bids, or waive defects in bids in the interest of the city.

By direction of the board of city affairs.

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C. A. HERBIG, City Comptroller.

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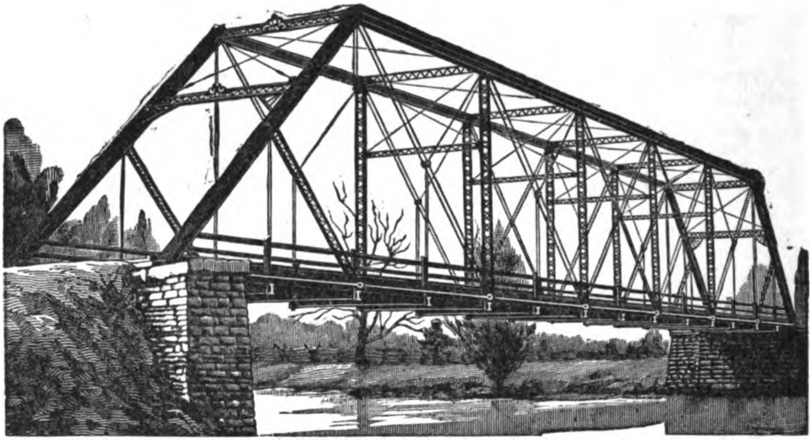

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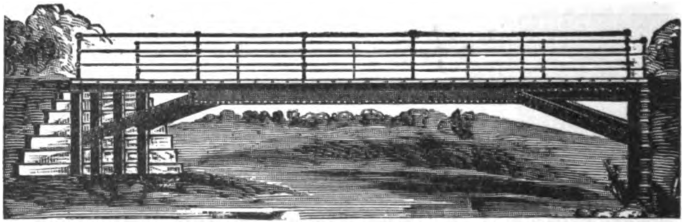

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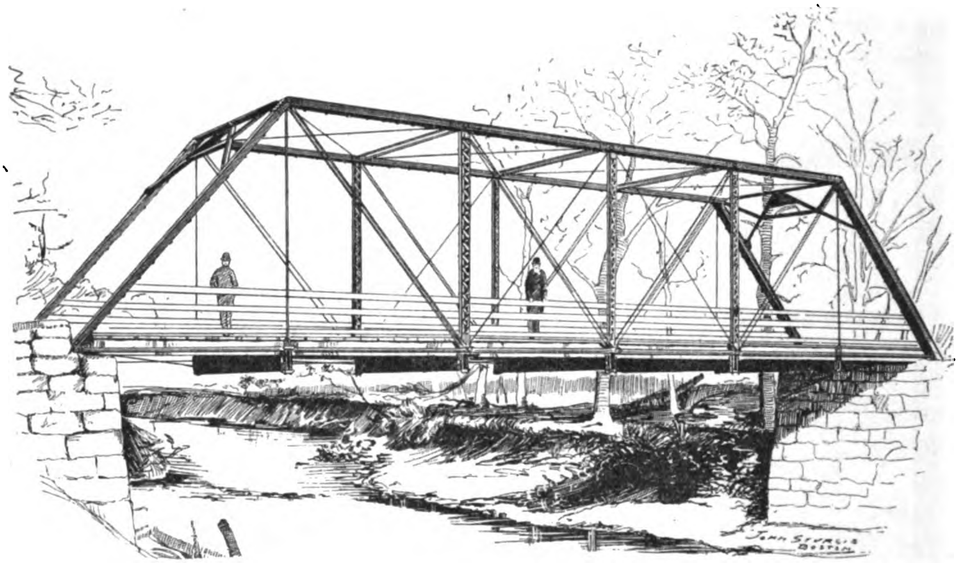

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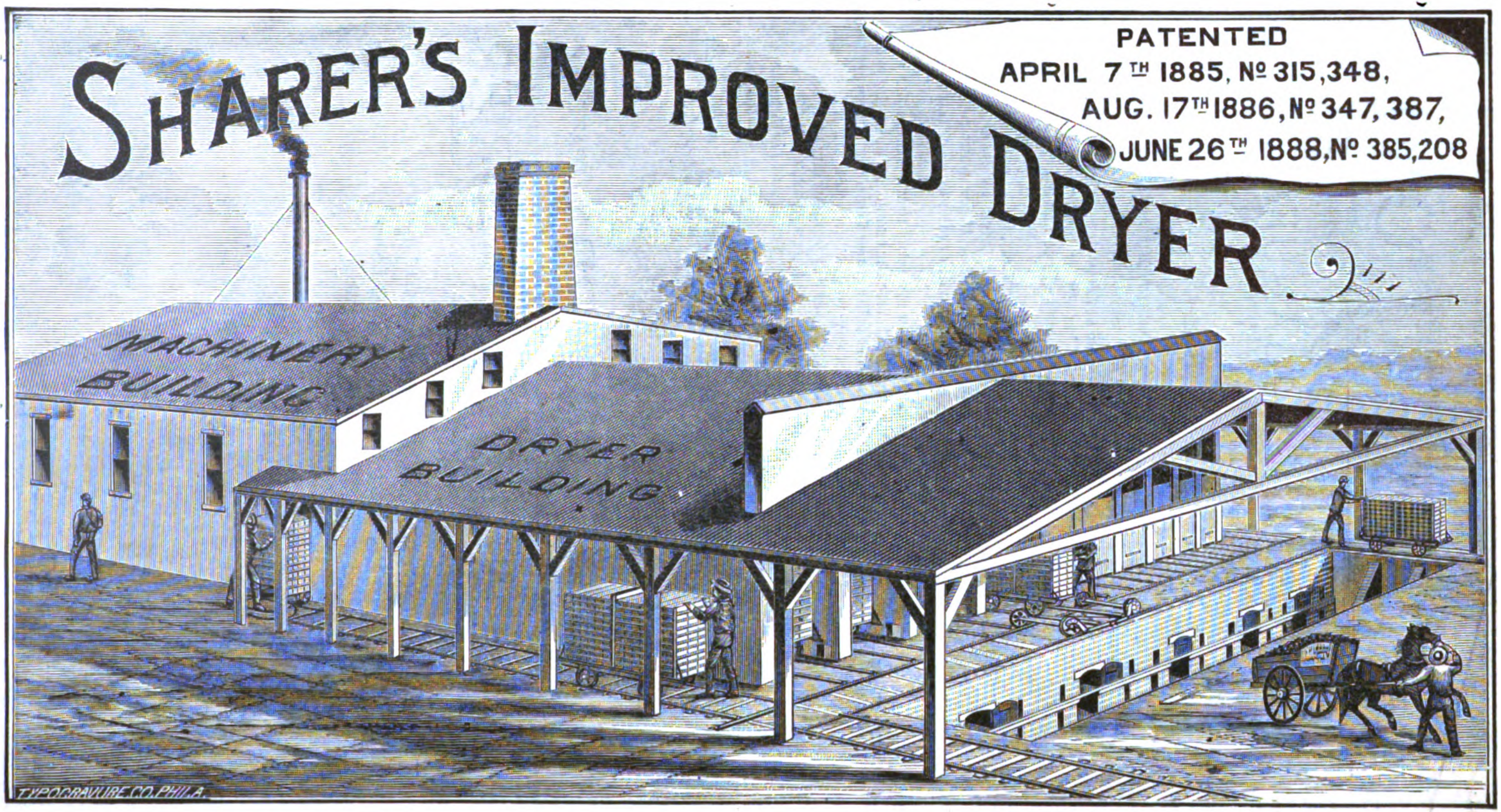

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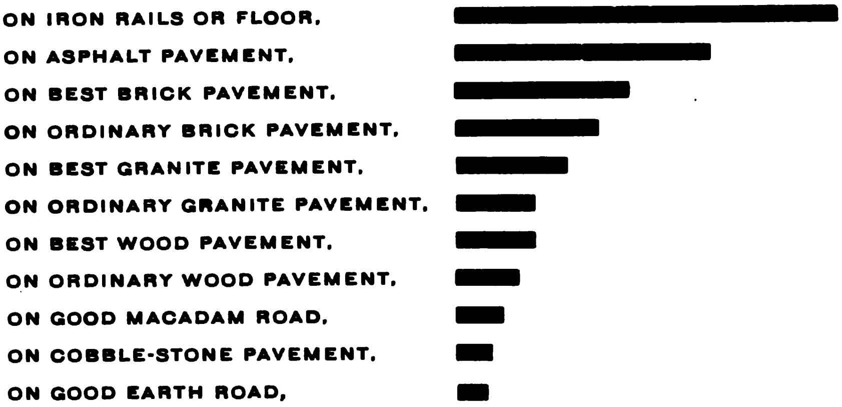

Extract from an article on Resistance to Traction on Roads, by Rudolph Herring, the eminent Civil Engineer.

> "If one horse can just draw a load on a level road *on iron rails,* it will take one and two-thirds horses to draw it on asphalt, three and one-third on the best Belgian block pavement, five on the ordinary Belgian pavement, seven on good cobble-stones, thirteen on bad cobble-stones, twenty on an ordinary earth road, and forty on a sandy road. Therefore, *a city paved with sheet asphalt will save to itself and its citizens from 200 to 300 per cent. of the cost, to it and them, of transporting passengers and goods, as compared with a city paved with blocks.* This saving will in a large city amount to thousands of dollars daily, and the yearly aggregate would doubtless be large enough to pave the city. It is a saving, too, that affects every person residing or owning property in the city."

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VOLUME IV. MAY, EIGHTEEN NINETY-THREE. NUMBER 5.

ANNEALING PAVING BRICK.

Recently there has been considerable letter-writing and discussion on the vitrification of brick, especially those intended for paving. Some contend for thorough vitrification, while others maintain that semi, or say partial, vitrification is all that is needed for good paving brick. This has been so thoroughly discussed at conventions and in the clay journals that I do not see much chance of writing anything new on the subject, but the impression forces itself upon me that when the term "vitrifaction" is clearly understood all round, discussion on the subject will to a great extent cease.

There is also another matter in connection with vitrified brick that appears to be to a great extent overlooked, which may account for the diversity of opinion so prevalent. That is the matter of annealing brick. The term "annealing" appears also to be shrouded in misconceptions and requires the same unanimity as to its meaning as the term vitrifaction. By consulting the dictionary we find—"Anneal, v. a., to temper glass or metals by subjecting them to intense heat and then letting them cool very slowly; to heat glass and earthenware so as to fix colors; to temper by heat; to bake, as tiles (A. S. *an*, and—*oelan*, to burn)."

From a practical standpoint of view this definition is rather vague. Tempering and annealing metals are two very different things, I might say opposite things. Take steel for instance, where we temper to impart hardness, but we anneal to make it soft. The object of annealing metals is to deprive them of brittleness and to render them flexible and ductile.

We will take the liberty of cutting out "tempering" from this definition of annealing and give it a place by itself, and for the present deal with annealing as generally practiced and understood. One portion of the definition is to the point and quite satisfactory to me, viz., "by subjecting them to intense heat (the glass or metals) and then letting them *cool slowly*." The italics are mine. I attach more importance to the slow cooling than anything else, this is what effects the annealing. Raising to a very high temperature is of no avail in annealing, if the slow cooling is not attended to, and it is astonishing what results may be attained when this cooling off is properly done; nails that would not bend to an angle of 90 degrees without fracture before annealing, could be tied into a close knot after annealing. In the Industrial Exhibition of 1861 might be seen a railway car axle tied into a knot; this was done cold after being annealed for one week. I say cold, but allowance must be made for the heat developed during the process of tying the knot.

Nearly all the metals are possessed of this property of softening by very slow cooling from a high temperature, care being taken, however, to exclude the air by imbedding the metal in some kind of powdered material; sand is very good for iron and steel, but it might be injurious to some of the metals. Powdered charcoal would probably do for some of the metals, but would frustrate the object in view if it were used to imbed iron or steel.

A little reflection leads us to the conclusion that steel and iron would be hardened by such treatment, and practice confirms this conclusion. The mistake has frequently been made of trying to soften or anneal wire and sheet iron by bedding them in saw dust and raising a heat on them, then letting it die out slowly. The result—spoiled wire and sheets—is always the same. This has occurred in establishments where steel making by the "cementation" process was carried on daily under the very noses of these misguided annealers. It never occurred to these men that the saw dust would soon char and would then convert into steel the iron in contact with it. Of course a man with ordinary intelligence does not fall into this error twice.

From instances of this kind we readily see that annealing is beset with conditions, besides slow cooling, and is not so simple an affair as it at first appears .The metal copper just reverses the operation; to anneal or soften copper it must be heated to a red heat and plunged into cold water. This renders it soft and pliable. Slow cooling hardens and stiffens it.

Glass comes under the same law as the generality of metals, and requires slow cooling to render it tough and elastic.

The Siemens Bros. offered railway companies glass "sleepers," or "ties," for their railroads, to replace the wooden tie, and it was claimed that the advantages gained by the glass tie would doubly compensate the railway companies over the difference in cost. They were to be strong and tough enough to resist all ordinary shocks and strains, and as far as deterioration from decay, etc., they were practically indestructible. The possibility of producing glass ties with such flexible properties centers chiefly in the annealing, and this leads me to the subject of this article, "Annealing Paving Brick."

If we desire to establish and maintain the reputation of brick paved streets and roadways, we must endeavor to endow the brick with all the good properties of granite, and if possible deprive it (the brick) of all the granite's objectionable features.

In the first place let us examine the characteristics of the modern, or up to date, paving brick, and do we not find it to resemble granite to a great extent in both character and composition? Would it be much out of place to call it artificial granite? The object sought and aimed for by the maker of vitreous brick is to return the clay to nearly its original state as rock, and he uses nature's method of doing it, viz, by heat, but his modification of the process will not admit of heating up to melting point, because his brick are already formed or molded. Over forty years ago I saw a process of brick-making in which the liquid (molten) clay was run into molds and set aside to anneal; the process was abandoned on commercial grounds. I see, every now and then, the same thing crops up again, and I firmly believe it will yet bear fruit. The process referred to is the utilization of blast furnace slag. The one I refer to specially was at furnaces smelting what is known as *clay* iron-stones. These lava bricks were put on the market to compete with the common building brick, which proved fatal to them, chiefly on account of their weight and the consequent heavy freightage. No particular pains was taken in cooling them. They received a moderate covering of dry sand. When I think over this long-ago experiment it occurs to me that if brick paving had at that time received the impetus of the present time the lava brick would in all probability have been made into excellent paving brick. This would have left no question as to its vitrifaction, and, with proper annealing, a tough and almost everlasting paver would have been made. The composition differed somewhat from the paver of to-day, inasmuch as it contained a percentage of lime that would render the usual method of brickmaking impossible. Compare the analysis of the vitreous paver and the lava brick :

	Vitreous.	Lava.
Silica	57.47	39.82
Alumina	32.69	15.10
Lime	1.85	31.48
Protoxide iron	4.01	0.79
Sulphide calcium	....	2.22
Magnesia	2.11	7.44
Protoxide manganese	....	1.62
Phosphoric acid	....	.15
Alkalies	1.96	1.89
	100.06	100.51

What confirms me in my belief about the slag paver is the fact that the slag was used far and wide to macadamize the roads, turnpikes, etc., and a good, solid road it made. A few houses were built, some twenty or more, of the large broken-up blocks. These were an experiment with the material, and it looks as well to-day as it did thirty years ago. The only draw-back to it was the cost of building. No attempt was ever made to anneal any of these large blocks of slag. They were run into iron moulds and sent to the dump as soon as they were set.

While writing this article I received by mail a neatly got up and well-written pamphlet, entitled "Brick and Brick Roadways," by W. S. Ravenscroft and H. A. Miller, and while complimenting them on the plain, practical way they handle the subjects treated of, I must take exception to the half off-handed style in which they treat annealing ; yet they are careful enough to lay down conditions that will insure annealing. They say, "The cooling off of a kiln should be very gradual, as the admission of cool air in the slightest degree has a tendency injurious to any brick, and especially to paving brick.'' Again they say, ''It is our belief and experience that when the burning of a brick has been finished it is as tough as it is possible to make it, and that the only thing necessary is to see that the cooling process is not too rapid.''

Here Messrs. Ravenscroft and Miller and I just agree. A brick, and especially a vitreous brick, is exceedingly tough when it reaches its final temperature, and the slow cooling recommended is to retain a portion of that toughness. The present method of manufacturing brick renders reheating unnecessary, but with the metals and glass reheating several times is sometimes necessary. If brick had to be reheated as much care would be needed for the heating as for the cooling; a quick reheating of brick would be as mischievous as quickly cooling off the first heating.

If Messrs. Ravenscroft and Miller consider it requisite to reheat, in order to anneal, and which may be inferred from the indifference they manifest towards it, or if they think that heating is the factor of main importance in annealing, then I beg to differ on both points. Brick, glass or metals may be carefully heated to any prescribed temperature and the annealing completely spoiled by the quick cooling. This they admit, but appear to confound cause with effect; they ignore annealing but prescribe that which will produce it.

And now let us consider the kiln that is most suitable for producing vitreous paving brick. Any good close-topped kiln that is not used to heat the air for the adjoining kiln. I think the continuous kilns unsuitable for good paving brick on account of the air being drawn through the hot finished brick and hastening the cooling of them; of course this saves fuel, but it undoubtedly spoils brick. My experience in metals confirms the statement of Messrs. Ravenscroft and Miller about the injurious effect of admitting air even ''in the slightest degree.''

From the above considerations we may conclude that merely vitrifying brick does not constitute them good pavers, and brick of the finest composition receiving the most careful and skillful treatment at the hands of the burner may be utterly spoiled by injudicious cooling, in order to save a little time or a few barrowfuls of fuel.

W. Waplington.

W. Waplington was born at Somercotes, Derbyshire, Eng., February 19, 1835. His father was a mining contractor, and took him into the mines when just turned nine years of age. Up to that time his education had been what the national schools in England then afforded. His mining experience was gained in the North of England, in the Marquis of Londonderry's collieries in the County of Durham. In 1856 he quit mining and turned his attention to the forge, foundry and rolling mills, and had the pleasure of witnessing the early experiments of Bessemer & Siemens in steel making, and about this time he commenced contributions to the local papers and to *London Engineering*. In the latter paper he commenced a discussion with the late Sir W. Siemens on the chemistry of puddling iron. During his mining days he was a diligent attendant at the night schools and scientific lectures. He was also passionately fond of music, and got fairly grounded in this delightful art under Mr. Joseph Kay, a basso chorister and teacher in Durham Cathedral. From 1856 to 1866 he was in the foundries and rolling mills of the Butterlay Company at Codnor Park, Derbyshire. He then went to the Atlas Steel Works of John Brown & Co., Limited, and was there six years, acquiring a knowledge of steel and armor-plate making, holding the position of assistant manager. In 1872 he took charge of the Lancashire Steel Works, operated at that time by Bolchow, Vaughan & Co., Middlesborough. In 1874 he was engaged by the Bessemer Steel and Ordnance Co., London, as manager and chemist at their works, East Greenwich. They closed down just before the end of the year, and he was at once engaged as technical manager to the Steel Company of Canada, the works to be built at Londonderry, Nova Scotia. Thither he was sent in June, 1875. In 1881 he came to the United States to build and take charge of a Bessemer steel plant at Wheatland, Pa., which never matured. From 1882 to 1884 he had no permanent position. At this time the Hon. E. A. Wheeler, of the Wheeler Iron Company, offered him the position of manager at their rolling mills, West Middlesex, and then offered him a partnership if they could lease the mills from his partner, Lloyd Reed. This they did, but before the end of 1886 Mr. Reed saw a good chance to sell the mills, etc., and for a consideration they allowed the lease to be cancelled. Since that time he has been giving his attention to the generation of heat by gaseous fuel, etc.

WIDTH OF PAVED ROADWAY IN CITY STREETS.

The most serious obstacle in the way of securing well paved streets in all our cities and towns is the great cost of such improvements and the unwillingness of the people to bear the burden of taxes and assessments necessary to pay for them. It is, of course, a fact that such burdens are rather fancied than real, since, in nine cases out of ten, a well-paved street is a good business investment for the property owners along it, but it is very difficult to get the average citizen to see it in that light; and while he can but admit that well-paved streets are a blessing, he usually regards the collection of assessments for such improvements an infringement on his liberty, or a species of legalized confiscation of his property.

It being universally admitted that well-paved streets are—bar-ring the fact that they must be paid for—desirable, and in fact necessary for the comfort of urban residents, it becomes an interesting problem how to reconcile the warring elements of cost and comfort, or in other words, how to secure well-paved streets at a reasonable cost.

Unfortunately, good pavements of whatever kind, like most other good things, are expensive, and the property owner is not generally able to withstand the temptation to favor an inferior article because it is cheap. As a consequence, few cities have escaped the curse of miles of so-called pavements constructed in the shabbiest manner out of the poorest materials, having no other virtue than low firstcost, but proving in the end so expensive that only the wealthiest communities can afford them.

As one possible solution of the problem, how to secure well-paved streets at a reasonable cost, the possibility and propriety of reducing the width of the roadway is suggested. Most of our American cities and towns have been laid out with streets of liberal width. This is particularly true of those parts of cities devoted to residence purposes. Wide streets are desirable for the free admission of air and light, and for their æsthetic effects. But the primary and principal function of streets is to afford means of intercommunication between the different parts of a city, and aside from the considerations named above, the width of any street should be determined by the requirements of such intercommunication, or in other words, by the amount of travel it is required to accommodate. Judged by this standard, any observant person must admit that the majority of the suburban and residence streets of our cities are unnecessarily wide. Viewed from this standpoint, it seems preposterous to provide a pavement forty or fifty feet wide to accommodate the few light and infrequent vehicles of the residents, and the occasional trips of the milk, ice and grocers' wagons that supply the people with the necessaries of urban life.

The question will naturally arise, why not, while securing the benefits of wide streets, make the paved portion of them conform to the requirements of travel?

Quite extensive observation has convinced the writer that a roadway from eighteen to twenty-four feet wide is ample to accommodate the travel that passes over the great majority of residence and suburban streets in American cities. There are, of course, in every city, a number of principal roads or driveways where wide roadways are necessary, but if one will consider the matter he will be surprised at the small number of such heavily traveled streets outside of the business portion of any given city; and if he will take pains to observe the amount of travel passing over streets other than such main arteries, he will be surprised at the smallness of its volume.

It may be stated as the average practice in American cities to make the roadway three-fifths of the total width of the street. This gives for a sixty foot street a roadway thirty-six feet wide, and it is customary, when the street is to be improved, to have the whole width of this roadway paved, regardless of whether it is or is not necessary to properly accommodate the travel to which the street is to be subjected.

It seems to the writer that this practice is a needless extravagance and a waste of public funds. In the case of at least four out of five such streets, not principal driveways or popular boulevards, a paved roadway eighteen feet wide will be found amply sufficient to meet all the requirements. The arguments in favor of reducing the roadway width on such a street from thirty-six to eighteen feet may be briefly stated as follows:

1st. Because the cost of paving the street is reduced one-half; and because of such reduction, it will be found easier to get the property owners to consent to the construction of a first-class pavement.

2d. The cost of cleaning or sprinkling the street is reduced one-half, or, in case it is not cleaned, there is only one-half the surface to supply the dust and dirt to be carried into the houses by the wind.

3d. While the cost of maintenance and repairs might not be reduced in proportion to the width, since such cost in the case of pavements not subject to natural decay is a function of the amount of travel over them, there can be no doubt that the cost of such maintenance and repairs would be greatly reduced.

4th. The narrow pavement leaves a wide space on each side of the street, which, after providing for ample sidewalks, may be sodded with grass or planted with trees, thus greatly increasing the beauty and comfort of the street, and practically adding to the front depth of abutting lots.

5th. There will be ample space between the curb and the sidewalk in which to lay all sewer, water and gas pipes, where they will be readily accessible for repairs without cutting into and disturbing the paved roadway.

This is a most important consideration, which I need not discuss in detail. As this plan contemplates placing a line of such pipes on each side of the street, it may be claimed that the cost of such pipes would be doubled. This would not be true, since not only would the pipes for the double system be smaller and cost less to lay, but the house connections would all be materially shortened, and their cost reduced, and the saving on the large number of these connections would probably more than balance the extra cost of the double lines of pipe.

6th. A paved roadway eighteen feet wide will allow two lines of vehicles to meet or pass each other freely. It is objected that teams could not be turned round in such a street. This is admitted (though it is not impossible for a skillful driver to turn a one-horse vehicle in a street eighteen feet wide between curbs), but if circular curbs, say of twelve feet radius are used at the corners, there will be ample room to turn at the street intersections; and even if drivers found it necessary to go around a square to make the turn, it would not be a serious inconvenience.

These advantages and the great economy that would result from the adoption of the plan make it worthy of more careful consideration than it has heretofore received.

Many people who habitually oppose innovations, whether they are meritorious or not, will resist the making of such narrow driveways, simply because it is not the "good old way." But if the plan is found to possess the merits claimed above, and no more serious objections to it appear than now occur to the writer, it is certain, like all other meritorious things, to be adopted in the end.

It is not, of course, claimed that the idea is new, or that it originated with the writer, but it has not heretofore received the attention it deserves, and it is with the hope of securing such attention and a full discussion of the subject that this paper is presented.

S. Whinery.

Mr. Whinery is president and general manager of the Warren-Scharf Asphalt Paving Company, located at Cincinnati, and is widely known professionally as one of the most successful engineers in the country.

THE GRAVEL ROAD MOVEMENT IN PARKE COUNTY, INDIANA.

Parke county, Indiana, was organized by the legislature in 1821. It contains 440 square miles. About three-fourths of the area is level, or gently rolling. The remaining fourth presents every aspect from gently sloping to precipice.

When the county was first settled, road workers were few, and it was all they could do to cut the timber out of the roadway, and corduroy a few unavoidable swamps. It was more than they could do to grade up the road beds. In order to get the driest road bed, the summits of the ridges were followed as long as they held out, then the travel plunged down their steep ends into the little valleys. Ox teems were generally used, horses being used mainly for riding. The policy was to put enough oxen to a load to draw it, and to break down all obstacles in the way. I have in the last year or two seen walnut logs sawed into lumber of less diameter than the early settlers often used for wagon and sled tongues. The young man who could drive three to six yoke of oxen, and crack his whip till it could be heard a mile, and swear till he shook the acorns from the oaks, was a neighborhood aristocrat, and could have the hand of the prettiest girl in the puncheon floor dances.

Those rude, primary trails, were by time and use worn into the principal roads. Houses and other improvements were built with reference to them, so that it has generally been impossible to relocate them. Travel across our county in any direction and we see roads of the worst possible location for us of to-day; but they were the only available locations for the early settlers, who could do no better.

After about twenty-five years, the practice of changing roads so as to conform to land and section lines began to prevail. This, in the rough country, did the roads more harm than the original bad locations. I know numerous instances where, to conform to a road line, the road now runs over the end of a ridge, or the swell of a hillside, where the distance around it would be less, and give incomparably better gradients.

As farms were improved our roads were confined to the lanes. Then the impassable mud holes were developed. Rails would be taken from fences to pry up mired wagons, and left in the mud holes where used till they became dangerous to subsequent teams; then fences would be opened and the travel would cross the adjacent fields as regardless of the protests of land-owners as would the floods of our rivers the protests of bottom farmers.

Until the session of 1876–7 our legislature gave us no free gravel road laws. Before that time we had toll road laws only. The first toll road through Parke county was the Indianapolis and Springfield plank road, which was finished to the Wabash river in 1851. It was delightful while it lasted as a road, which was about five years. It lasted as a nuisance about five years more. Because it was chartered as a plank road it had to be a plank road. It was like the boy who went fishing for cat. The first bite he got was from a four-pound bass. He took it off his hook and flung it back into the stream, saying: "When I go a catting, I go a catting." That plank road in many places was built alongside of gravel banks and gravel bars, where one cast of the shovel would have put the gravel on the road, where it would to-day be doing service. The last mile and a half was planked on the Wabash second bottom over as good gravel as was ever placed on a road, and which we now haul three to four miles to make gravel roads. But the stockholders and directors were a plank roading, and it was idle for a bass to bite their hook.

How much we do from the force of habit. Our people have at last got into the habit of hauling gravel onto the common roads; and this fall I saw farmers working out their road tax by hauling gravel from a pit and dropping it onto a road-bed composed of better gravel than they were hauling three-quarters of a mile. In addition to the force of habit, the fact that a farmer is limited in his work to his own road district causes some of these absurd actions. In his own district the roads may not need the gravel; but as he would get no road tax credit if he should haul into another district where his gravel might be needed, causes him to do needless work in his own. As he has team, wagon and time, he prefers working out his tax to paying money, only to be paid out to others by the supervision for the same useless work.

If any county in the state ever had worse roads in the rainy season than Parke county I am glad I never saw them. As roads in the rough, or raw, as we might properly say, were good at the time in the year when farmers were too busy with farm work to travel them much, and bad at the only time they had to spare, neighbors' acquaintance with neighbors was of necessity very much restricted. The area of each family's range was generally limited to the distance the members could walk of a night across fields and woods to a school-house or "meeting-house." With such a limited association each neighborhood had litle knowledge of the ways and customs of others, and of course they "judged themselves by themselves." Their knowledge of things, and their ways of doing, were the ways by which all the rest of the world should be squared. There was little or no social harmony between town and country. The "country Jake," as he dragged himself through his road mud-holes into the village, looked like a mud-turtle. There he met the village dandy, tip-toeing along over his split-log sidewalks with his shining boots, who represented the dry-land terrapin. Of course there grew up and remained that inevitable and irrepressible distinction between the clean and the dirty. The "country Jake" resented this manifest distinction with rude actions and scowls, and was answered by the village "Chawley" with sneers and contempt.

Our numerous gravel roads have done away with nearly all I have here described, and which I well remember to have existed when I was a boy and young man. Country and town have become homogeneous in Parke county. A carriage load of villagers will sail out into the country and take dinner or tea with a farmer's family, and the visit will in due time be returned.

The gravel-road movement in Parke county had the smallest possible beginning. About the year 1863, when the whole country thought of little else than war, Hon. Thomas N. Rice, a lawyer of Rockville, was elected road supervisor, mainly as a joke. Four road districts then cornered at the court-house in Rockville, and the streets were worked simply as common roads. Mr. Rice did not want the office at first. He had a good split-log sidewalk from the court-house to his residence, and the flat sides were up, and some of them were fully fifteen inches broad on their face. The grace with which he could tip-toe over those logs and spring from one to another would have provoked the envy of a dancing-master if there had been one. What did he care for that elongated mud-hole called a road or the "country Jake" who waded it?

After he had taken that solemn oath of office, an idea struck him.

He would play the people a joke which would never become stale, for the older it grew the more it would be enjoyed. He would not call out the hands, or assign any work to any person by which he could pay his property road-tax, but he would let the money accumulate. The next year he sought the office and was triumphantly elected. He again held back the work, and allowed another year's road tax to be paid into the treasury. Then the word got out that he had nearly $300 road money in his possession which the honest toilers had paid into the treasury. What did he mean? Did he intend to skip the country? A great storm of indignation raged. When he found he could not be re-elected, he induced a friend who was onto the secret to allow his name to be used, and if elected to fail to qualify, when Mr. Rice would be appointed. His friend was elected over him by a majority compared with which Cleveland's is insignificant. The storm of opposition spent its force at the election. The successful candidate declined to serve, and Mr. Rice was appointed supervisor. He continued his former policy, and at the end of the year had over $400 on hand. He then solicited the property-owners on Howard avenue in Rockville to donate to his enterprise twenty cents per lineal foot of their ground, which most of them did. Before his term expired he let a contract to grade and gravel that street twelve feet wide and one foot deep for nearly a half mile. The storm of protests and indignation which then greeted Mr. Rice from those on other streets and alleys in the same road district now seem ridiculous in the highest degree. But their points were then considered well taken by the grumbling public.

Mr. Rice and a half-dozen others, his disciples, took a spade and examined the bars on Williams creek to see if enough gravel could be obtained. They thought by careful shoveling it could be had. It is historically well attested that this was done on a Sunday afternoon. Mr. Rice is now a prominent and zealous churchman. Even then he was not above suspicion of having church tendencies. But no Sunday's work he ever did has resulted in more good to this world than did the examination of those gravel bars. Of the value of his later abundant Sunday-school work to be measured where the streets are paved with gold it is yet too early to judge; but he is known here where all can walk safe on his gravel.

Every community has a wise and general purpose man. This man took a pencil and a shingle when the first street was to be graveled and demonstrated that the bars of Williams creek could not contain gravel enough to gravel Howard avenue twelve feet wide and one foot deep. Beside that, what was the use of graveling one street when all the others of necessity must do without it? Then the grumblers called attention to the fact that Mr. Rice had done all this work on the street on which he resided. He would have been denounced none the less had he graveled any other street instead of his own. I had not then grown into the importance of being a surveyor and civil engineer. I was only county treasurer, a circumstance due to a badly aimed shot from the confederate army which failed to kill me. I desired a re-election, and it was important that I should prove that I was smart in figures. I joined the objectors, and where the wise man had figured out a probable deficiency of gravel, I figured it out absolutely so. Bad as my figures were afterward proven to be, they were clearly the best to be made at that stage of the campaign. While we were demonstrating, objecting and croaking, Mr. Rice built his road. But we still had something left to growl about. The gravel was put on while other roads were dry and hard, and the loose gravel made it hard pulling while it was packing. We growled on till the fall rains made all other roads impassable, and this road good. Then ended all the glory of the opposition. That was the first attempt at gravel road building in Parke county. After the next flood all the bars on Williams creek were refilled. We have since graveled about eleven miles of road and street from those bars, and to-day we can't see that a pebble is missed.

The next effort at graveling was the north and east side of the public square. Mr. Rice took a leading part in that movement also. This work was put through under the law for assessing the property holders on each side of the street. It was hard coaxing to get the county commissioners to see that the county was liable to pay its share of the work. The then leading commissioner voted against the appropriation, and placed a protest on record. He has long since been a very pronounced friend of gravel roads, and would doubtless read that protest now with a blush.

About a year later, to wit, about 1866, Dr. H. J. Rice (brother of the former) and Joseph L. Boyd circulated a petition to build a gravel road from Rockville to Bellmore, a village seven miles due east. It was built under a law then in force taxing the land three quarters of a mile on each side of the road, each land owner being a stockholder to the amount of his tax. Such a road became free in twenty years. The petition was very defective, and the proceedings in the court were also erroneous; but the construction was rushed through so rapidly that it was an accomplished fact before the objectors could growl up an organized opposition. If it had been undertaken a year later, when the reaction against gravel roads was on, it could easily have been defeated.

The next move was to grade, gutter and gravel Ohio street from the public square to the next street east. I took the lead in that small movement. It was done under the law to assess property owners on each side. I had then been fully converted to the practicability of gravel roads.

The year 1867 an effort was made to build a gravel road from Rockville seven miles north to Annapolis. Stock was subscribed and a company organized under the turn-pike law. It was partly constructed, when a law was passed allowing roads to tax the land one and a half miles on each side and from the termini. I think the law permitted roads partly constructed to tack about and finish under that law. At any rate that was attempted. It reached out so far on side and end that it took in people who had but little interest in the road, who became objectors, and especially there grew up a contention whether a road had a beginning and an end, or whether it had two ends. The right to tax one and a half miles from the "termini," as the law provided, gave rise to that discussion. When a gravel road falls into the hands of a debating society that road is doomed. This road passed through Bloomingdale, the then intellectual center of Parke county. While there were very few there who could take one share of stock at fifty dollars and pay it up, there was no end to those who could give wagon loads of advice, worth ten thousand dollars to any enterprise; and they gave it freely. While very little of this advice helped the cause of the road, it nearly all gave a deal of trouble and annoyance to the opposite side. All these parties were for the gravel road, but not one but would for all coming time wade through deeper mud than he had ever seen before he would have a road built on the plan and by the means proposed by the opposite side. At last five persons proposed to take the road and complete it, provided the original stockholders would abandon their stock and allow the five to own the road when done. All were tired and agreed. I personally lost one hundred and fifty dollars by that road.

In the meantime the citizens of Rockville went on graveling their other streets, till all the principal ones were completed to the corporation line.

An effort was made in 1868 and 1869 to build a road from Bellmore via Hollenburg and Portland Mills to Russellville in Putnam county, under the law taxing one and a half miles on each side and beyond the "termini," as before mentioned. This road ran several miles on the county line, and this added some subjects for the debating society to discuss. Hon. Thomas N. Rice, before mentioned, was one of the attorneys employed by the objectors to defeat the road. It was interesting to listen to his arguments against this road, as an attorney, and contrast them with the arguments he had formerly used as supervisor. This road dragged along in court a year or two and died. That long discussion as to whether a road had a beginning and an end, or whether it had two ends, was all gone over again, and hairs were split finer than cobweb threads.

One of the means used to kill the last mentioned road was a stock company road, organized to occupy and claim part of the same right of way claimed by the former. When the former died, the latter died also and was buried in the same grave.

J. T. Campbell.

Capt. John T. Campbell, of Rockville, Indiana, was born in Parke county, one and a half miles east of Montezuma, May 21, 1833. He attended two terms of the then locally famous Bloomingdale Academy, under Prof. B. C. Hobbs. When the rebellion broke out he volunteered in the 14th Indiana Infantry, and was twice rejected for defective teeth. Later, a permit was granted to raise the 19th, 20th and 21st regiments, Indiana volunteers, and he was elected and commissioned captain of Company H., 21st Indiana Volunteer Infantry, July 6, 1861. He was wounded in the battle at Baton Rouge, August 5, 1862, from which he still suffers. He was appointed assistant provost marshal under Captain Thompson (later Secretary of Navy under Hayes). In 1863 he was elected county treasurer of Parke, his native county, and re-elected in 1865. December 15, 1864, he married his second cousin, Annie Butterfield, in Butler county, Ohio. While riding with her there, he saw some very fine turnpikes and gravel roads. She claims, and justly so, no small share in the glory of raising Parke county out of the deepest mud on to the best and most numerous gravel roads of any county in America, as she largely converted their most active promoter to the cause of good roads. She constantly reminded him of the difference between his rides with her in Ohio, and her rides with him in Parke

county, Indiana. Before his acquaintance with her he thought the only remedy for mud roads was stronger vehicles and bigger horses. After his conversion to good roads he worked, urged, argued, demonstrated and wrote in the county papers for better roads, and suggested routes. Many times he thought his agitation made no impression on the people, but after the passage of the free gravel road law of 1877, Parke county had an epidemic of gravel road building. The fact that adjoining counties having the same law and equal material, yet building no gravel roads, is proof that his agitation had prepared the minds of Parke county people for the improvement.

In 1871 he matured a radical and complete road system in statutory form, on which he took out a copyright, but offered it free to Indiana if the legislature would adopt it as a whole. The session of 1871 would doubtless have passed it but for the bolt of the house on account of political measures. The senate committee reported it favorably and the house committee signified their intention to so report. He offered it to five subsequent legislatures on the same terms, but each session showed less and less disposition to adopt it. A legislature is a queer thing; it seems that the best work they ever do is by accident or inadvertence. If a live measure is actively considered, it developes a conservative opposition that defeats it. The English Parliament established the freedom of the press in England by forgetting to put on a new muzzle when the old one had dropped off by the statutes of limitation. Before another Parliament met England discovered that a free press was better than a muzzled press. Let us hope that at no distant time, some legislature will stumble onto a good road law, for they seem determined never to step onto one purposely.

MUNICIPAL OWNERSHIP OF STREET LIGHTING PLANTS.

A COMMITTEE, composed of N. B. Acheson, Edward McGinnis, H. B. Chase, George Welsch, J. L. Botsford, Peter Deibel and J. W. Dickey, was appointed recently by the common council of Youngstown, Ohio, to investigate the municipal ownership of electric street lighting plants in cities of about the population of Youngstown. The committee did its work thoroughly and made a valuable report. From the information gathered a very comprehensive table was compiled of which the accompanying exhibit is the most essential part.

In submitting the report the committee said:

"We find that there are at least one hundred and twenty cities in the United States that own their own electric lighting plants, and as such are profitable to those cities, and that one out of fifteen of the total number of electric lighting plants in this country are municipal institutions. We find that New York City, Boston, Chicago and Detroit, as well as smaller cities, are at present making investigations in this line. We have written to all of those cities that own their electric lighting plants that we could hear of, asking of each a list of questions calculated to gain the desired information, and have received replies from seventy-three, which we have at-

ELECTRIC LIGHTING PLANTS OWNED BY CITIES.

NAME OF TOWN.	System in Use.	No. of Arc Lights.	Candle Power.	Is Plant operated in connection with other works?	Fuel used.	Cost.	Cost of the Plant.	Incandescent Lights for private use.	Charge for them.	Number in use.	Arc Lights cost the city each per year.	Was city furnished Electric light by private corporat'n previous to owning its own plant?	What did you pay per light for same?	Do your citizens believe it wise for the city to own the plant?
Atlantic, Iowa	Slatry			No	Coal	$1 35	$25000 00	Yes		1500		No		*
Albany, Mo	Westinghouse	30	1200	"	Wood	2 00	11000 00	"	*	1000	0	"		Yes
Alexandria, Va	Schuyler	92	1500	Yes	Coal	3 07	16000 00	No			$55 00	"		"
Alexandria, Minn	T. & H.	10	1200	"	Wood	2 00	6000 00	Yes	65c	ov'r 600	about 7 00	Yes	120 00	"
Arlington, Minn	Edison	4	1200	"	"		28000 00	"	75c	*100	200 00	No		
Ashtabula, Ohio	Westinghouse	120	500–2	No	Coal	2 20	25000 00	"	50c	600	77 00	Yes	76 00	Yes
Attalla, Ala	West'n & Nat'l	25	2000	Yes	"	1 65	10000 00	"	70c	150	80 00	No		"
Aurora, Ill	G. El. Co. & W'n	162	2000	"	"	1 81	41800 00	No			58 44	Yes	326 92	"
Bay City, Mich	Ft. Wayne El. Co.	180	2000	No	Shavings	pr yr 1750 00	30000 00	"			46 00	"	100 00	"
Blufftown, Ind	T & H.	85	2000	"	Natural Gas	100 00	10500 00	"			60 00	"	75 00	*
Bloomington, Ill	T. & H.	220	2000	Yes	Coal	1 75	78000 00				50 00	"	111 00	Yes
Clarion, Iowa	Incandescent			No	"	2 30	8000 00	Yes	*	700		No		"
Chariton, Iowa				"	"	1 20	22000 00	"	Aver. 50c	1200		"		*
Chambersburg, Pa	T. & H.	72	2000	Yes	"	3 00	20000 00	No			78 00	"		Yes
Coldwater, Mich	T. & H. and W'rn	70	2000	"	Oil	100 gal 1 72		Yes		2800	less th'n 60 00	Yes	25c pr n't	"
Council Grove, Kas	T. & H. and W'rn	29	1200	"	"	3 60	8000 00	"	*	43	75 00	No		"
Crawfordsville, Ind	W'rn Arc & N'l	141	2000	No	Natural Gas	2400 00	70000 00	"	40c	2100	25 50	Yes	71 42	"
Crete, Neb	T. & H.	50	1200	"	Water	100 incad.	8000 00	No			0	No		"
Chehalis, Wash	Edison	80	2000	Yes	W'd & Saw'st	Wood 1 59	10000 00	Yes	*	440	8 00	"		"
Dunkirk, N. Y	W'rn El. Co.	75	2000	"							41 43			"
Emmans, Pa	West'ghouse Alt.	12	2000	No	Coal	2 50	3000 00	No			48 00	No		"
Easton, Pa	W'rn El. Co.	108	2000	"	"	2 85	30000 00	"			81 44	"		"
Fairfield, Iowa	Brush	14	2000	Yes	"	2 30	6000 00	"			72 00	Yes	150 00	"
Fredonia, N. Y	Ft. Wayne	57	2000	No	"	2 15	13000 00	"			85 00	No		"
Gainsville, Ga	T. & H.	50	1200	Yes	Wood	1 50	10000 00	Yes	*	35		Yes	75 00	"
Galion, Ohio	Ft. W. Jenny	72	2000	No	Oil	16 10 pr gal.	30000 00	"	50c	850	65 00	No		"
Grand Ledge, Mich	Jemez	15		"	Coal	*	6000 00	No	60 00		60 00	"		"
Hannibal, Mo	Wood Arc	100	2000	"	"	2 00	20000 00	Yes	50 to 75c	2000	60 00	"		"
Herrington, Kas	T. & H.	28	1200	Yes	"	2 00	29000 00	"	75c	620	0	Yes	100 00	"
Herkimer, N. Y	Edison	50	2000	"	"	2 68	14000 00	No			50 00	No		"

High Point, N. C	Am. El. Co.	32	...	No	Wood	2 00	6000 00	Yes	50 to 75c	100	...	No	...	Yes
Huntington, Ind	Ft. Wayne Jenny	...	2000	"	Gas	per yr 800 00	15000 00	No	...	...	55 00	"	...	"
Jamestown, N. Y	Wood	187	1200	...	...	...	28000 00	...	...	...	43 92	...	...	"
Leon, Iowa	Edison	...	...	No	Coal	1 85	...	Yes	*...	500	*...	...	...	*...
Luverne, Minn	W'rn A & W'gh	40	2000	Yes	"	3 85	*...	"	50c	455	...	No	...	Yes
Londonville, O	Wood	40	2000	No	"	2 50	18000 00	"	*...	725	...	"	...	"
Little Rock, Ark	Ft. Wayne	136	2000	"	"	3 15	39700 00	No	...	...	69 88	"	...	*...
Lewistown, Me	Wood	100	2000	"	Water Power	...	16000 00	"	...	...	43 00	Yes	109 00	Yes
Marietta, O	Wood & Indpls	110	2000	"	Coal	1 25	18000 00	"	...	...	60 00	No	...	...
Montesano, Wash	Westinghouse	...	...	"	Wood	2 25	6224 75	Yes	1 25	...	...	"	...	Yes
Madison, N. J	T. & H. Alt.	30	...	Yes	Coal	...	20000 00	"	10	600	...	"	...	"
Marshalltown, Ia	" "	65	1200	"	"	1 25	12000 00	No	...	...	*...	Yes	100 00	"
Madison, Ga	" "	40	2000	No	"	2 00	22000 00	Yes	*...	175	80 00	No	...	*...
Madison, Ind	Jenny	86	2000	"	"	1 49	20000 00	No	...	...	62 00	"	...	Yes
Marquette, Mich	Brush & Wst'ghs	100	2000	"	Water Power	...	70000 00	Yes	*...	2700	40 00	"	...	"
Middletown, Pa	Wood, T. &. H.	51	2000	"	Coal	1 95	25000 00	Yes	*...	500	0	"	...	"
Michigan City, Ind	Jenny	50	2000	Yes	"	...	10000 00	No	...	...	...	"	...	*...
Miamisburg, O	T. & H.	46	2000	No	"	1 75	12000 00	Yes	*...	800	52 00	"	...	*Ys
Martinsville, Ind	Ft.W J'y & B. Eng	30	2000	Yes	"	*...	5000 00	No	...	...	33 00	"	...	...
Metropolis, Ill	Ft. Wayne	30	2000	No	"	1 15	6000 00	Yes	*...	300	...	...	...	...
Oxford, O	Westinghouse	36	...	...	...	...	23400 00	"	½c meter	1300	* 0	...	...	*...
Peabody, Mass	Edison & T. & H.	...	1200	...	Coal	4 20	50000 00	*...	...	...	91 85	...	...	*...
Peru, Ill	Edison	...	...	Yes	"	*...	20000 00	Yes	60c to $1	650	...	Yes	*...	Yes
Painesville, O	Western	70	2000	No	"	2 10	12000 00	No	...	...	43 60	"	72 00	"
Paris, Ill	Ft. Wayne	90	2500	Yes	"	*...	10000 00	"	...	...	28 00	No	...	"
Rock Port, Mo	Edison	...	...	"	"	2 90	6000 00	Yes	50, 60, 70 & 75c	* 406	*...	"	...	"
St. Charles, Ill	T. & H. and Ft. W	150	32c. p.	No	"	2 50	9000 00	...	...	...	* 12 00 in l'ts	...	...	"
Shelbine, Mo	Royal	*...	...	"	"	2 00	7000 00	Yes	10 L 50	310	...	No	...	...
Stuart, Iowa	Hawkeye	...	...	"	"	1 75	15000 00	"	*...	1300	...	"	...	Yes
St. Peter, Minn	T. & H.	45	2000	Yes	"	*...	17000 00	"	50 to 65c	675	*...	d'tno	...	"
St. Clairsville, O	Westinghouse	30	2000	No	"	...	10000 00	"	*...	400	33 65	No	...	"
So. Norwalk, Conn	Western	90	2000	"	"	3 75	*22500 00	*...	...	...	...	Yes	*...	...
Shelby, O	T. & H.	44	2000	"	"	*...	19600 00	Yes	30 to 55c	725	56 00	No	...	...
Schuyler, Neb	Edison	10	2000	Yes	"	25	7500 00	"	40 to 50c	600	...	"	...	Yes
Savannah, Mo	T. & H.	25	1200	No	"	1 00	12000 00	"	35 to 50c	450	* 72 00	...	...	"
Santa Cruz, Col	Brush	74	1200	Yes	Wood	3 50	...	No	...	...	50 00	No	...	"
Tecumseh, Neb	Edison	...	...	"	Coal	2 15	5000 00	Yes	*...	485	...	...	...	"
Tipton, Ia	Brush, Edison	4	2000	"	"	3 85	...	"	50c	200	75 00	Yes	166 66	No
Webster City, Ia	Mathes	...	...	"	"	1 65	24000 00	"	*...	2100	...	No	...	Yes
Wilton Junction, Ia	Edison	...	...	"	"	2 15	7000 00	"	35c	450	...	"	...	"
West Troy, N. Y	Edison, Ball	90	...	No	"	3 00	22000 00	No	...	...	60 00	Yes	70 00	"
Wheeling, W. Va	Wood	400	2000	Yes	"	.04⅓ pr bu.	100000 00	"	...	...	50 00	No	...	"
Wytheville, Va	Edison & Sperry	25	1200	No	"	2 75	...	Yes	*...	300	...	"	...	"

tached to this report in the form of a table, that by reference to it information may be quickly and easily obtained.

"We find that Albany, Mo., Crete, Neb., Herrington, Kan., Middletown, Pa., and Oxford, O., have municipal plants, and from the profits derived from the commercial arc and incandescent lights furnished by them are able to pay all of the expenses of the plants and furnish the street lights without cost to their taxpayers, which is certainly a splendid showing.

"We find the prices in other citied varies from seven dollars for each arc street lamp per year all the way up to and more than is paid in this city, but at the same time we find the price varies nearly in proportion to the price of fuel in those cities, and as coal for our water-works is furnished at about one dollar and ten cents per ton, we believe that we are favorably situated to get cheap and efficient lighting service.

"The street arc lights for this city cost $67.50 per lamp per year, and we now have 237 of them, and at this price—which is considered very low for a private corporation to furnish—amounts to $15,997.50, and, in addition to these, there are 389 vapor lights costing $14 each per year, or nearly $5,446, which, added to the cost of the arc lights, makes a total of $21,443.50, or about one-sixth of the whole amount received from taxes for municipal purposes that is paid for street lighting alone. * * *

"When this city owns and operates an incandescent plant with the arc light plant, it would, as other cities do, derive profit enough to nearly, if not entirely, pay for the cost of running such an institution, as well as the interest on the necessary bonds for its purchase or erection, and get the street lights for little or nothing.

"One thing is certain, there would be no combination or tacit understanding between the city and the gas company as to who should occupy this or that street, and the price and quality of gas would be more satisfactorily regulated by competition than all of the legislation that could be made would accomplish. We believe that the city should issue its bonds for this purpose, and the control of these plants should be placed in the hands of the water-works trustees.

"We, therefore, recommend that the necessary steps be taken to procure legislation enabling this city to issue its bonds in an amount not exceeding $100,000, at not more than 6 per cent. interest, for the purpose of erecting or purchasing, owning and operating an arc and incandescent electric lighting plant for street and commercial purposes.''

The council decided to submit question to a vote of the people.

Mayor Pingree, of Detroit, is an advocate of municipal ownership of street lighting, and has had three estimates on the cost and operation of a plant in that city prepared for the consideration of the Detroit Council. The estimates are as follows:

Estimate No. 1.—For 2,000 arc light plant, complete, with fireproof building, direct coupled engines and dynamos:

Real estate and building	$35,800 00
Boilers and appurtenances	44,000 00
Engines and connections	58,000 00
Dynamos and station electrical appliances	70,000 00
Contingent, 5 per cent	10,090 00
Total cost of station	$217,890 00
Lamps, lines, etc.:	
Distributing converters	$30,000 00
2,000 arc lamps	60,000 00
2,000 iron poles or mast arms, complete, at $20	40,000 00
500 miles of pole line, $200 per mile	100,000 00
20 miles of conduit system, including copper wire, complete	80,000 00
Contingencies	10,000 00
	$320,000 00
Total investment	$537,890 00

Cost of operation and maintenance per year, station to run 12 hours per day, at 2,000 horse power:

Office expenses	$6,000 00
Power plant employes	11,540 00
Fuel and maintenance	24,090 00
Repairs, and depreciation of power plant, at 5 per cent. on $172,800	8,640 00
On building, at 2½ per cent	600 00
Oil, waste and supplies	3,000 00
Interest on station and power plant, 4 per cent. on $201,800	8,072 00
	$61,942 00
Cost per horse power per year delivered to line	27 97

Cost of maintaining lamps and lines per year, 2,000 lights:

Trimmers, repairers and underground conduit men, 35; at $2 per day	$25,550 00
2,000 pairs of carbons, per day	14,600 00
Repairs and depreciation on lamps, lines and converters, at 3 per cent	6,900 00
Repairs and depreciation on conduit system, at 3 per cent	2,400 00
Interest on lines, lamps, conduit system, etc., at 4 per cent	12,800 00
	$62,250 00
Cost per lamp per year for line and lamp maintenance	31 12
Total cost per year	124,174 00

Total cost per lamp per year:

Expense of commissioners' office per lamp per year	$3 00
Cost of power delivered to line per year	27 97
Cost of lamp and line maintenance per year	31 12
	$62 09

Estimate No. 2.—

Cost of plant, as per Estimate No. 1	$537,890 00

Cost of operation and maintenance per year, based on moonlight schedule of 1893; calculated on plant to start one half hour after sunset and one hour before moonset, and to stop one hour after moonrise and one hour before sunrise.

Hours of station operation:

	H.	M.		H.	M.
January	206	10	July	152	00
February	193	40	August	164	20
March	175	40	September	180	20
April	153	50	October	212	10
May	144	10	November	219	00
June	137	50	December	244	20
				2,183	30

Total cost per year:

Expense of commissioner's office	$6,000 00
Cost of power	42,627 00
Cost of lamps and line maintenance	54,930 00
	$103,557 00

Total cost per lamp per year:

Expense of commissioner's office	$3 00
Cost of power per lamp per year	21 31
Cost of lamp and line maintenance	27 46
	$51 77

A saving of $20,640 per year in cost of operation over Estimate No. 1.

Estimate No. 3.—

For 2,000 arc light plant complete, with fireproof building, engines, driving countershaft, belted dynamos:

Real estate and buildings	$45,000 00
Boilers and appurtenances	72,000 00
Dynamos and station electrical appliances	65,000 00
Contingent	11,400 00
Poles, lines, etc	47,000 00
Total cost of station	$240,400 00
Lamps, lines, etc	300,000 00
Cost of operation and maintenance per year, station to run 12 hours per day	66,255 00
Cost of horse power per year delivered to line	33 12
Cost of maintaining lamps and lines	60,450 00
Cost per lamp per year	30 22
Total cost per year:	
Expense of commissioner's office, per year	$6,000 00
Cost of 2,000 horse power per year	66,255 00
Cost of maintaining lamps and lines, per year	60,450 00
	$132,705 00
Cost per lamp per year	66 33

Operated under the moonlight schedule, as per estimate No. 2, the cost of maintenance per lamp per year will be $56.

A CITY ENGINEER'S VIEWS ON MODERN STREET PAVING.

[Mr. Niles Meriwether, city engineer of Memphis, Tenn., in his recent annual report concisely makes some valuable suggestions on street paving, which are given below.]

As regards the best material for street paving, and the best methods of construction, a great deal may be said.

A great deal depends upon the location, soil, gradients and drainage, conditions and requirements, as well as upon climatic conditions, no two places being, in all respects, alike. Again, the amount and character of traffic, and its proper regulation, enter as prime factors into the consideration of any paving material. There are so many various conditions that it is quite impossible to make any fixed rule which shall be of general application. That which may be within reach and means of one place may be wholly beyond that of another, hence, in the consideration of this question, the opinions of engineers and others are often greatly at variance. Nearly all, however, agree that no durable or satisfactory pavement can be made or maintained for any great length of time, unless founded on a good concrete base, whether the wearing surface be of granite, asphalt, brick, wood, or any other paving material, the amount and character of traffic being considered.

The sheet asphalt comes nearer being the ideal pavement for all conditions and uses. It must, however, be properly constructed and be of the very best material and have constant attention. As now constructed by skilled and experienced hands under scientific methods, it is the most beautiful pavement laid and withstands an enormous amount of vehicular traffic.

Many fine examples of the best modern construction are now to be seen in a number of places, notably in New York City and in Philadelphia.

But this pavement, more than either granite or brick, is affected injuriously by dirt and moisture, and requires to be kept as clean and dry as possible. It is sometimes injured by gas escaping from leaky mains beneath. It is, however, easily repaired and cleaned, and if properly cared for, in a timely way, after prescribed methods, it is one of the most satisfactory pavements that can be laid.

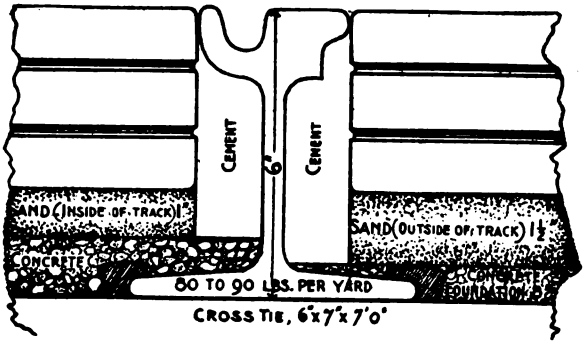
The modern brick pavement, built in accordance with the best practice, on moderate grades, makes a superior pavement, and is destined to come into general use, especially in the smaller cities, where the traffic is not excessive, on account of the difference in cost as compared with granite and asphalt.

With an extended experience in burning, and otherwise perfecting brick for paving purposes, much greater durability, under increased traffic, may be looked for.

While it can not now be said that brick will withstand, for the same time, the heavy traffic carried by either granite or asphalt, yet it has, in many respects, the essential qualities for a superior pavement. It is nearly impervious to moisture; it is quite noiseless; it affords good footholds and offers little resistance to traction; it is adapted to grades of two or three feet per hundred or more; it is easily cleaned, and is not greatly affected by water and dirt, or by acids; it can be rapidly and cheaply laid, and readily repaired or renewed at moderate cost, and under moderate traffic (fifty to sixty tons per foot of wheelway) will last eight or ten years without repairs.

On all streets upon which street-car lines are located, owing to the number of breaks in pavement surface, it is advisable to lay the brick at right angles to the line of street, except at street intersections, where they should be laid at an angle. On all other streets, wherever used, they should be laid at an angle of forty-five degrees. This method, it is believed, will prolong the life of the pavement several years.

Where the traffic of a street is heavy and continuous, and when cost and noise are secondary, the durability with least repairs is a prime consideration, all authorities agree that a first-class granite block pavement stands first. Such pavements are now laid at from forty to forty-five cents per square foot on eight to nine inches concrete foundation, and when properly laid will sustain a traffic of two hundred tons per foot of wheelway per day, with moderate repairs, for fifteen or more years.



Telford and macadam pavements, on account of the low price (in first cost) at which they can be built, as compared with granite, asphalt, brick and wood pavements, will continue to make up the principal mileage of street pavements in most cities. When constructed after approved specifications and with good material, excellent pavements can be made; but, as traffic increases, the expense for maintenance grows apace and with great rapidity.

In making repairs, filling holes and ruts and resurfacing, the tendency is to excessive crowning of street, which can only be avoided by picking over and redressing of surface before adding new material, all of which increases cost of maintenance in this form of pavement over that of others named. But notwithstanding the first cost being so much below that of the other, it will continue to be extensively laid, especially in the smaller cities and towns where the means for building pavements are limited.

Just here we may properly ask of what use is it to build good streets at great cost (no matter of what material) if they are to be destroyed in a few years by the continued use of the present narrow wheel tires? It would be hard to conceive of a more destructive vehicle on streets, as well as on animals, as that of the dray with its rough, springless body and dead weight, mounted on two wheels, having but two and three-quarter inch width of tires. With such an instrument of destruction it is useless to expect any street to withstand, for any great length of time, its destructive effects combined with that of the elements.

There is room for reform and great improvement in this respect. The width of all wheel tires, more especially those for trucking purposes, should be regulated in accordance with the loading or carrying capacity, distribution of load and build of vehicles, giving preference to those with springs, or to express it differently, each square inch of wheel tire should have a fixed limit of load to carry per square inch of bearing surface per wheel, including weight of vehicle. To illustrate, take the common two-wheel dray, having about 2¾-inch tires, weighing say 750 pounds, loaded with six bales of cotton and driver, say 3,100 pounds, and we have a total of 3,850 pounds, or 700 pounds per square inch of wheel tire, dead weight; put this in rapid motion and it means death and destruction to all around.

In the interest of commerce, progress and general advancement of economy, humanity and individual comfort, the subject is worthy of study and of serious consideration by the citizens of every municipality.

Statistics and proofs relating to all these matters are constantly being compiled by able and experienced engineers and builders of roadways, streets and other municipal works, and they are everywhere in reach of anyone who may be interested in the subject.

Niles Meriwether.

THE SEWERAGE SYSTEM OF MEMPHIS.

[THE review of the Memphis system of sewerage, embracing suggestions as to how it may be improved and protected, was recently submitted to the common council of that city, as given below, by Mr. George E. Waring, Jr., the engineer who had charge of the work.]

So long a time has elapsed since the present system of sewerage was begun that it may not be amiss to recall its history. My first connection with the subject was late in 1879, when I came to Memphis as an engineer of a committee of the national board of health, which was charged with the recommendation of sanitary improvements, intended to prevent a recurrence of the epidemics of yellow fever, which had for two successive years devastated the town, ruined its prosperity and greatly reduced its population.

Those who have known Memphis only after the regeneration that followed that period can form little idea of the sad plight in which this great disaster had left it. Its sanitary condition had never been good, and when the people began to return to their homes after the exodus of the second fever year, it was as bad as it could be. The spirit of the leading men of the city at that time was, however, most admirable. They determined that whatever the board of health committee should advise must be carried out, and that the stricken town should be again put upon its feet, and should start right for its renewed strength. They foresaw the advance that was possible, and they determined to pave the way for it.

The splendid modern city of to-day is a monument to their manly and resolute effort, the full value of which can be appreciated only by the few who know the woeful condition from which they have raised it. It was decided that the first work of improvement should be the construction of a system of sewerage. But sewerage was very costly, and the community was very poor. Some years before a plan of sewerage had been made, which would cost enormously more than it was possible to pay; there was no method of city sewerage then in vogue by which what was determined to be immediately necessary could be constructed for less than $500,000. Less than one-half of this amount was available.

I had recommended a theoretical system which had never been put into execution—which probably never would have been put into execution but for the great needs and the great poverty of Memphis.

This system consisted of small earthenware pipes, carrying foul sewerage only, from which all rain water was excluded, and in which the occasional, irregular and unreliable flushing during rains, was to be replaced by the daily discharge of automatic flush tanks at the heads of all the branches of the sewers. It commended itself to all the health authorities and to the leading citizens, and its adoption was urged by the council.

Many a hard battle had to be fought against ignorance, timidity and stupidity before the order for its construction was finally given. I made three separate visits to argue in its favor, twice before the council and once before a large meeting of citizens at the Cotton Exchange, where it was, after a long and hot discussion, accepted by an acclamation, against which only one single "no" was raised.

The discussion concerning details was long protracted. In the course of this it was determined that in view of the defective water supply from Wolf river, which was then in use, it would be an ample allowance to provide for a water consumption of 40 gallons per person per day, or 2,000,000 gallons for a population of 20,000. The actual daily consumption, at the present time, is more than 6,000,000 gallons. My original estimate provided for a full supply of man-holes, costing, as I remember, about $15,000. It was decided that we could get along with some cheaper substitute, and that if man-holes were found to be necessary in future, the richer future city could afford to build them. So the man-holes were omitted. For a like reason, the main sewers were confined to a size barely sufficient for 2,000,000 gallons capacity. I remember that Dr. Porter argued before the council that it was a great advantage of the system that it could be built with main sewers adapted to present needs, and that supplemental mains could be laid when they were needed, and when the city could better afford to build them. At last, the order was given, and ground was broken on the 21st of January, 1880. I collected together a party of 18 assistant engineers, from various parts of the country, only two or three of whom had ever done any sewer work, and none of whom had ever seen such sewers as we built here. Men, materials and tools were collected in great haste, and a rush was made to put in as much sewerage as possible before June 1, which the board of health fixed, as the latest time at which it would be possible to stir up the polluted soil without danger. We worked for about twenty weeks, fully five weeks of which time was lost by bad weather, generally heavy rains. This rainy weather was so distributed that the ground was in a very bad condition nearly all the time.

During fifteen weeks of actual working time, in spite of innumerable difficulties, we invented our processes, organized our forces, procured our supplies, and built more than eighteen miles of sewers, including the brick main from the jail to Jackson street, and the two main sewers east and west of Bayou Gayoso; we did this at a cost, including the engineering and superintendence, of less than $140,000.

If time has shown that something less than absolute perfection was secured, here and there, I think it may still be said that, considering all the circumstances, we did reasonably well.

The work then done had its desired effect of aiding to improve the sanitary condition of Memphis, and of showing to the world that this condemned city had taken on a new life, that it was earnest in its determination to overcome the disastrous effects of its epidemics, and that it offered a hopeful field for enterprise. During the 13 years that have since passed, it has maintained its promise, and from that moment of its regeneration it has gone bravely on and has by its prosperity astonished the world, which in 1879 would have been glad to see it swept off the face of the earth, as a dangerous public nuisance.

The work then done has had another effect—it has revolutionized the methods of sewering the smaller towns. Not only have the principles first set forth here in 1880 been adhered to in the construction of the 32 miles of additional sewers built in Memphis, but the same system has been adopted in all parts of the country, until it is safe to say that, in work executed and now in hand, the total length of similar sewers is not less than 1,000 miles.

It has attracted attention and has found some imitators in other countries, and the name of Memphis is known, because of its sewers, in some quarters to which its fame would not otherwise have penetrated.

Naturally, as with all new processes, modifications have been made in the arrangement, construction and maintenance of this system, but these modifications have generally been improvements, but in its essential feature the system remains the same to-day that it was when first adopted here in 1879.

These features are:

1. The use of pipes so small that the stream sent through them will flush them sufficiently.

2. The exclusion of storm water.

3. The substitution of regular automatic flushing for rain or hand flushing.

These features will, in my judgment, come more and more into favor as times goes on.

This is the system that you have in use in Memphis, crude in some regards, as it was learning its first paces at the hands of inexperienced men a dozen years ago along the slopes of Bayou Gayoso, and doubtless more complete and workmanlike as the experienced engineers of the city have constructed it in other portions. On the whole, I think we all have good reason to be satisfied with it.

I have been invited to make a careful inspection of the sewers in their present state, and to make such recommendations concerning them as seemed to be proper. To this end I have gone carefully over the work with President Clapp, Maj. Meriwether and Mr. Elliott, and I have been given the fullest opportunity to see all that I desired to see, and the fullest and frankest information has been cordially furnished me. I find that there are now in service 50½ miles of sewers of the system under consideration. There are, in connection with the system 253 flush tanks and 478 man-holes; there are about 7,000 house connections. The house connections receive the wastes of the following fixtures: Water-closets, 9,672; slop sinks and catch basins, 6,920: bath tubs, 1,149; waste basins, 840; urinals, 666; laundry tubs, 194; latrines, 12.

It is said in a general way that the lateral sewers of the system have ample capacity for their work. It is reported that they never run half full, and that they rarely run one-third full. The brick sewer runs about half full, and the east and west mains run less than full, when they are not gorged with water from rains and when they are clean. Some years ago the east and west mains were intercepted at Monroe street by a sewer running from that street to the river; but for this interception the mains north of Monroe street would now be overtaxed most of the time.

In one respect these sewers are called upon for a duty they are not intended to perform—that is the removal of a large amount of storm water. In spite of the most careful, proper and sufficient regulations, with sufficient penalties provided for by the ordinance passed in 1880, the plumbing and drain-laying work on private property was for years allowed to take care of itself. Any kind of plumbing and any kind of drain-laying, for which the most penurious owner employed the most incompetent mechanic, was allowed to be done by the utterly neglectful sewer department.

The property-owners of Memphis must, now or later, repay, with heavy interest, the amounts saved by their former parsimony in this matter.

The sewerage system will never be satisfactory until these gross defects are remedied. I am glad to see that under the present administration the president of the city and the engineering department are upholding Mr. Lunn in his efforts to secure an absolute compliance with the rules and regulations established concerning the methods of house plumbing, and of connecting private premises with the public sewer. Success in this direction means success to the whole system of sanitary drainage, and the establishment of health conditions, which have always been aimed at, but which have heretofore not been fully secured.

In addition to the bad sanitary conditions sure to follow neglect in this matter, especially in the case of the poorer tenements—and these are the usual starting points of epidemics—the injury to the sewer system has been most serious. Aside from the obstructions to the proper flow of the sewers, of which Memphis has had an unprecedented crop, there has also resulted, from careless work on private property, a great inflow of storm-water, during and after every heavy rain. In some cases there is leakage about the fixtures, especially about and over the tops of yard catch-basins. In others, rain-water leaders have been willfully discharged into the catch-basins; and in very many more cases the connecting drain in the ground, leading from the fixtures to the public sewer connections, is laid with leaky joints, so that it acts as an underdrain and carries to the sewers the water saturating the ground after rains. I judge that the amount of water thus introduced into the sewers within two or three days after a heavy rain amounts to at least four or five times as much as the flow of sewerage proper passing within the same period.

This extraneous inflow should be stopped, at any necessary cost. In the matter of obstructions due to the former neglect of proper control above referred to, Memphis leads the world; there are more stoppages here, per mile of sewerage, in one week, than occurs in towns where the system is properly guarded, in a whole year.

For example, Stamford, Conn., has about 12 miles of six-inch sewers, which have been in use for about six years. It is a flat town, and most of the sewers are laid on a slight inclination. The warden told me last month that they never had a single stoppage in the sewers, and only three in the house drains, due to the gross carelessness of the users. The house drains of Memphis may be, and should be, made so good as to produce the same result here. The man-holes and inspection pipes of Stamford have never been opened except from curiosity; not one of them has ever been used since the work was finished, and this is the experience of many other towns having this system of sewerage.

So far as the sewers themselves are concerned, in Memphis, their chief defect seems to me to be that they are not adequately flushed. The flush tanks discharge from 110 to 130 gallons, and the discharge occupies probably from 45 to 75 seconds. This was originally supposed to be sufficient, but experience here, as well as elsewhere, has shown that it is not so. The whole discharge should be as much as 150 gallons, and it should be shot into the sewer in 20 seconds or less. The siphon available when this work was done was not quick enough in its action, but we have a siphon now in use which will discharge 150 gallons in from 13 to 15 seconds.

Under the conditions now existing in Memphis, the lateral sewers accumulate deposits, and these deposits foster the growth of a troublesome fungus; this fungus and the deposits accumulate during dry weather. When a heavy rain falls, enough of its water runs into the laterals to wash much of this accumulation into the main sewers, where the man-holes help to prevent its immediate and complete removal. The mains are then gorged, sometimes to overflowing, until by repeatedly passing the wire brush through the pipes, the obstructions are cleaned out. The sub-mains and laterals are then brushed, and the system works properly, until another period of accumulation. So long as the sewers receive the intelligent and careful attention now bestowed on them they will continue to perform their work as they now perform it.

Something, much better than this, however, is needed to constitute such a perfect sanitary system of sewerage as Memphis should have. The sewers should keep themselves clean ; they should not be dependent upon intelligent care. While they remain thus dependent, however, a larger force of workmen should be at the disposal of the engineer having charge of them. The present small force is not able to do the work properly.

1. More efficient flushing should be provided. The present tanks discharge into the sewers an average of about 120 gallons in about 50 seconds, or at the rate of 2 4-10 gallons per second. Tanks should be constructed which would deliver 150 gallons in 20 seconds, or at the rate of 7½ gallons per second. One hundred and fifty gallons would fill about 115 feet of 6-inch sewer, entirely full, and such a discharge would have a scouring effect very materially greater than that of the present flush. This, when delivered with such rapidity, would, in conjunction with an occasional ball cleaning, keep the sewers in better condition than it is possible to secure by manual labor. The renewal of the tanks would not cost more than about $10,000. Aside from the much needed improvement they would effect, they would save an annual outlay of over $2,000, or the interest at 5 per cent. on $40,000. They would maintain the sewers in a state of cleanliness that could not be approached by any practical brushing by hand. I think this the most important improvement to be made.

2. Openings should be made in the sewer connections near the property line, with suitable movable covers, and with the aid of these openings the flow of water during and after rains should be so examined as to determine the amount of actual rainfall, and if underground drainage flowing to the sewers from any given private premises. Strenuous measures should be taken to prevent such flow by requiring property owners to provide other means for the discharge of rain water. The sewers are not intended for such use,

and they can not be so used, without interfering with their efficiency for their legitimate service.

3. Obstructions should, wherever possible, be traced to their origin, and the plumbing fixtures and slop sinks of offending parties should be so arranged as to prevent a further admission of articles large enough to cause obstructions in the public sewers.

4. With all their advantages, man-holes have, in some cases, drawbacks that it would be well to remedy. Especially in the east main, and to a less degree in the west main. The sewage in time of excessive flow rises in the man-holes considerably higher than the sewer, and a pool of sewage rises and stands in them. Floating filth rises to the surface of each pool and makes the man-holes very foul. As the flow recedes this filth is carried into the sewer in masses which may accumulate and obstruct the flow. In cases where this is likely to happen—in all cases, that is, where the flow rises above the benches of the man-holes—the channels through which the sewers pass should be covered with iron plates laid on the benches to keep the solids within the course of the moving current, so that they would be carried to the outlet. Such places, properly supplied with lifting staples, could be conveniently handled.

It is hardly necessary for me to say, that, however good a system of sewers may be, they can not be trusted without help or supervision to keep themselves clean, neither can they be expected to cope with the carelessness and heedlessness of those who use them. This difficulty can be properly met, only by the supervision of an intelligent engineer, armed with authority to enforce rules, and controlling a sufficient force to maintain good conditions.

George E. Waring, Jr., Consulting Engineer.

ASPHALTUM IN THE UNITED STATES.

[From the Eighth Report of the Mineral Resources of the United States, just issued, by J. W. Powell, director of the United States Geological Survey.]

The total output of bituminous rock in California in 1891 was 39,962 short tons, worth at the point of production, exclusive of cost of transportation, $154,164. Kentucky produced 3,360 tons of bituminous rock, worth $2 per ton at the mines. The amount of gilsonite and bituminous limestone from Utah was 1,732 short tons, worth $82,100. It has been customary to give the value of gilsonite at St. Louis, to which city the product is shipped for sale and manufacture. This custom has been adhered to in this report. The bituminous limestone was sold in Salt Lake City, and the value of this portion of the product has been taken at its selling price in that city. We have then, as the total value of the asphaltum products in 1891, $242,264, an increase of $51,848 over the value of the product in 1890.

The bituminous rocks of California and Kentucky do not materially differ. It is in each case a sandstone impregnated with bitumen, the value being determined by the amount of pure bitumen contained. This product is used principally for street paving, for which comparatively little preparation is necessary.

Considerable attention is being paid to the bituminous sandstones of California. Several of the mining companies have pooled their interests, looking to the development of the best of the many properties, to the further introduction of the material in the arts and manufactures, and maintaining the industry upon a profitable and satisfactory basis.

The consumption of California bituminous rock must, however, remain restricted to a practically local community until such arrangements can be made with transportation companies as will admit of its being brought into competition with Trinidad and other foreign asphaltum in the Eastern market. The condition of the Kentucky product is as yet undetermined, the product for 1891 having been experimentally used for street paving. If proved satisfactory it will probably find a good market in Louisville, Cincinnati and adjacent cities. The California rock is used largely in San Francisco, Oakland, Los Angeles, etc., but owing to difficulty and expense of transportation reaches no market distant from the coast.

The form of asphaltum which has been styled "lithocarbon," and said to be found in great quantities on the line of the Southern Pacific Railroad in Texas, is still a matter of technical interest, as press notices from time to time indicate. It has not been shown, however, that any active steps are being taken to develop the property and place the mineral on the market. If all that is claimed for it be true there should be small delay in getting it before the country.

The following table shows the annual product of asphaltum and bituminous rock since 1882:

PRODUCTION OF ASPHALTUM AND BITUMINOUS ROCK SINCE 1882.

Years.	Short tons.	Value.
1882	3,000	$10,500
1883	3,000	10,500
1884	3,000	10,500
1885	3,000	10,500
1886	3,500	14,000
1887	4,000	16,000
1888	50,450	187,500
1889	51,735	171,587
1890	40,841	190,416
1891	45,054	242,264

The amount of asphaltum imported continues to be largely in excess of the domestic production. The island of Trinidad furnishes the greater portion of the supply, 71,112 tons of the 102,433 tons imported during 1891 being from that source. The remainder of the imports are made up of bituminous limestone from Sicily, Germany, Switzerland and France, and a small amount of asphaltum from Cuba.

ASPHALTUM IMPORTED INTO THE UNITED STATES FROM 1867 TO 1890.

Years ended—	Quantity.	Value.	Years ended—	Quantity.	Value.
	Short tons.			Short tons.	
June 30, 1867	....	$6,268	June 30, 1880	11,830	$87,889
1868	185	5,632	1881	12,883	95,410
1869	203	10,559	1882	15,015	102,698
1870	488	13,072	1883	33,116	149,999
1871	1,301	14,760	1884	36,078	145,571
1872	1,474	35,533	Dec. 31, 1885	18,407	88,087
1873	2,314	38,298	1886	32,565	108,528
1874	1,183	17,710	1887	30,808	95,735
1875	1,171	26,006	1888	36,494	84,045
1876	807	23,818	1889	61,952	138,163
1877	4,532	36,550	1890	78,861	223,368
1878	5,476	35,932	1891	102,433	299,350
1879	8,084	89,635			

As stated above, 71,112 tons of the asphaltum imported in 1891 were from Trinidad. The most of this was used for street paving, the number of square yards of Trinidad asphaltum laid during the year by all companies being 2,141,049, an increase of nearly 300,000 square yards over 1890, when the amount of paving laid was 1,857,000 square yards. To further illustrate the growth of this industry the following tables, showing the total amount of Trinidad asphaltum imported and the number of square yards of paving laid annually since 1880, are given:

IMPORTS OF TRINIDAD ASPHALTUM BY ALL COMPANIES FROM 1880 TO 1891, INCLUSIVE.

Years.	Long tons.	Years.	Long tons.
1880	3,918	1887	26,503
1881	6,707	1888	35,137
1882	14,263	1889	52,881
1883	23,309	1890	54,692
1884	19,630	1891	71,112
1885	15,289		
1886	27,757	Total	351,283

The number of square yards of Trinidad asphaltum laid in the United States in the past eleven years is as follows:

NUMBER OF SQUARE YARDS OF TRINIDAD ASPHALT PAVING LAID IN THE UNITED STATES FROM 1880 TO 1891, INCLUSIVE.

Years.	Square Yards.	Years.	Square Yards.
1880	106,838	1887	799,335
1881	116,629	1888	757,101
1882	196,184	1889	1,130,863
1883	387,510	1890	1,857,000
1884	424,524	1891	2,141,049
1885	403,882		
1886	623,188	Total	[a]8,944,103

[a] Equivalent to 586 miles of roadway 26 feet wide.

Trinidad asphaltum is being used for street paving in the fifty-nine cities in the United States and Canada named in the following list:

Cities Where Trinidad Asphalt Pavements are Used.

Washington and Georgetown, District of Columbia.
Denver, Colorado.
Savannah, Georgia.
Chicago, Cicero, and Peoria, Illinois.
Fort Wayne and Indianapolis, Indiana.
Topeka, Wichita, and Wyandotte, Kansas.
Covington, Louisville, and Newport, Kentucky.
New Orleans, Louisiana.
Baltimore, Maryland.
Boston, Massachusetts.
Detroit and Grand Rapids, Michigan.
Minneapolis and St. Paul, Minnesota.
Kansas City, St. Joseph, and St. Louis, Missouri.
Omaha, Nebraska.
Long Branch and Newark, New Jersey.
Albany, Amsterdam, Binghamton, Brooklyn, Buffalo, Dunkirk, Lockport, Long Island City, New York, Rochester, Schenectady, Syracuse, Troy, and Utica, New York.
Cincinnati, Cleveland, Columbus, Toledo, and Youngstown, Ohio.
Allegheny, Altoona, Erie, Harrisburg, Philadelphia, Pittsburg, Scranton, and Wilkesbarre, Pennsylvania.
Newport, Rhode Island.
Chattanooga, Tennessee.
Montreal and Toronto, Canada,

In eleven of the above cities the Trinidad asphalt paving was laid for the first time in 1891. These cities were: Denver, Colorado; Cicero and Peoria, Illinois; Covington and Newport, Kentucky; Grand Rapids, Michigan; Minneapolis, Minnesota; Long Branch, New Jersey; Amsterdam and Dunkirk, New York, and Newport, Rhode Island.

Mr. C. S. Chamberlin, secretary of the Sicilian Asphalt Paving Company, of New York, reports that his company imported into the United States during 1891 5,000 tons of crude bituminous limestone from Sicily and 1,500 tons from Germany, and estimates that the amount of bituminous limestone imported by other parties was about 500 tons.

The following pavements made from a mixture of Sicilian and German bituminous rock have been laid up to the close of 1891:

	Square yards.
1886 to 1891, at Rochester, New York	58,390
1886 to 1889, at St. Augustine, Florida	30,000
1889 to 1891, at New York, New York	84,599
1890, at Allegheny, Pennsylvania	6,041
1891, at Philadelphia, Pennsylvania	1,576

Of these there were laid in 1891 at Rochester, New York, 10,000 square yards; in New York city, 49,335 square yards, and in Philadelphia 1,576 square yards, a total of 60,911 square yards.

E. W. Parker.

CURRENT INFORMATION.

REMARKABLE SALE OF A STREET RAILWAY FRANCHISE.

In some respects the most remarkable offer for a street railway franchise ever received by any city in the United States has just been submitted to the municipal authorities of Indianapolis, and has been accepted by them.

In anticipation of the expiration of the charter of the company at present operating the street railway system of the city, known as the Citizens' Street Railway Company, there has been much agitation during the last three years as to what position the municipality should take with reference to a new franchise. Some have advocated municipal ownership of the plant and the leasing of it to an operating company; others have strongly favored the sale of the franchise, framed so as to require all desired service on the best terms that could be secured. The latter course was adopted by the board of public works, and it proceeded to prepare the kind of a franchise it was willing to sell, and announced that it would be disposed of to the highest bidder on April 19th. The company at present operating the system has maintained, however, that its charter does not expire until 1901, claiming that an extension of seven years had been given by a resolution of the common council in 1883. More recently it has intimated that it believed its charter to be perpetual. As the proposed new charter was much more favorable to the city than the old one, the present company, believing evidently that there would be no offer for the franchise, refused to bid. Unexpectedly to the public, on the day for opening bids a proposal was submitted by an unknown company which has since become somewhat famous as "the Great Unknown," and deposited $25,000 in cash as a guarantee of the fulfillment of its bid.

The proposal was far more liberal than had been expected. The board of public works had stipulated in the franchise that the minimum of gross earnings to be paid the city should be 2½ per cent. for the first five years, 5 per cent. for the second five years, 6 per cent. for the third five years and 7 per cent. for the remainder of the time. The offer of the company was ten per cent. per annum for the first five years, 12½ per cent. for the second five years, 13½ per cent. for the third five years, and 14½ per cent. for the remainder of the time, thus giving the city increasingly a liberal share in the earnings as the city grows in population. It is estimated that the bid will be equivalent to the payment of $11,000,000 for the franchise. Some idea of the increase in value of the franchise, due to the rapid growth of the city, may be gathered from the fact that five years ago the street railway was bought for $1,080,000, and last year was sold for $3,250,000, and efforts are now being made by the present company to negotiate bonds for $9,000,000 on a showing of earnings sufficient to warrant it.

The result has been so very satisfactory that the course of the Indianapolis Board of Public Works will undoubtedly become an example for other cities in the United States.

The proposed charter comprises twenty-nine sections. The first and second state that the agreement is to be made by the city through the board of public works as the party of the first part and —— as the party of the second part, and gives the authority for the making of such an agreement. Section 3 names the streets upon which tracks are to be laid and maintained. They are the same as those now occupied by the Citizens' Street Railroad Company. Section 4 stipulates that the contracting company shall not have the right to build lines on any other streets than those named until permission has been obtained from the board and city council, except that the right to build a line from Washington street to the city limits north and south will be granted; and provided, also, that the company shall discontinue any of the specified lines when agreed to by the board and council and the company.

Sections 5 and 6 limit the period of the grant to thirty years from 1893, and provide for the payment to the comptroller, quarterly, the following minimum per cents.: First five years, 10 per cent. on gross receipts; next five years, 12½ per cent.; next five years 13½ per cent., and for the remaining term of the contract, 14½ per cent. This shall be in addition to city taxes. Section 7 requires a register in each car, the keeping of an accurate statement, showing the number of trips made and the amount of fare collected, a monthly statement and exhibit of books, and the appointment of a committee of three by the mayor to examine such report.

Section 8 provides that a single cash fare shall not exceed 5 cents, which shall entitle the passenger to all transfer privileges; that six tickets shall be sold for 25 cents, and that children three years old and under shall be carried free when in care of a proper guardian. Section 9 requires the maintenance of a transfer system by means of tickets, furnished to passengers by conductors, good on any line of the company within the city limits; no transfer car or station, however, shall be maintained.

IMPROVEMENTS AND REPAIRS.

Section 10 requires the company to pay for the paving between all rails, including the space between double tracks or tracks and switches, and for a distance of eighteen inches outside of the outer rails with granite blocks on concrete foundation or with the same material as is used on the rest of the street or at the discretion of the board of public works. The company shall be assessed for such part of the improvement by the board of public works and shall pay in the same manner as do abutting property-holders who do not take the benefit of the ten year plan. On streets that have been heretofore paved, on which there are now car tracks, where the paving of that part of such streets as is occupied by such tracks has been paid for by abutting property-holders, the company shall within one year pay into the city treasury the cost of so much of said pavements as is included between tracks and rails, and such sum shall be paid pro rata by the treasurer to the property-holders against whom the cost of said improvement was assessed.

This refers to brick, granite or asphalt streets.

Section 11 stipulates that the company shall keep its portion of the streets in repair, and at all street crossings not paved the space between rails and for ten inches on the outside of rails shall be planked by the company to the full width of the street and sidewalk crossed by the tracks. In Section 12 it is provided that the company shall sweep, clean and sprinkle the portion of the streets occupied by its tracks when such streets are cleaned and sprinkled by the city. The company may elect to do its own cleaning and sprinkling, otherwise the board shall cause the same to be done at the expense of the company, in the usual manner.

In Section 13 it is provided that the tracks shall be located on such parts of streets as shall be approved by the board, and the board reserves the right to designate on what streets double and single tracks shall be laid. Section 14 relates to the kind of rail used and provides that it shall not impede the passage of vehicles nor the flow of water. The right of action against the company for violation of this and other sections is stipulated.

EQUIPMENT OF THE LINES.

By Section 15 the company is required to use first-class equipment; to provide conductors, in addition to motormen or drivers, for all cars; to provide for the heating and lighting of cars by electricity or other means acceptable to the board, and to provide life-guards.

In Section 16 the company is required to do all in its power to advance any street improvements by moving tracks, poles, etc. By Section 17 the operation of cars may be temporarily stopped by order of the board, and by Section 18 it is provided that in time of danger from fire or other cause the fire department chief may order any of the company's wires cut. Cars shall not be allowed to run over any hose belonging to the fire department.

PROVISION FOR TIME SCHEDULE.

Section 19 provides that cars shall be run over each line on a schedule not exceeding ten minutes between cars between 6 A. M. and 11:30 P.M., and not less than one car each hour thereafter until 6 A. M.; but upon said cars between the hours of 1 A. M. and 4 A. M. the company shall have the right to charge 10 cents a passenger; and it is further provided that upon such lines as may be agreed upon by the board and the company the latter may be relieved of running cars after midnight, provided that it agrees to run cars upon any or all of its lines at such intervals as may be necessary to provide ample accommodations.

The speed of cars is limited by Section 20 to twelve miles an hour, and six miles an hour at such crossings as the board may designate. Cars shall stop at the further side of crossings. Penalties for violations of this are provided.

By Section 21 it is stipulated that the city shall not be liable, independently or jointly with the company, for accidents that occur in the construction or operation of the lines; and the company agrees to pay any judgments obtained against the city for damages caused by the fault of the company, and hold the city free from harm.

By Section 22 the company receiving this charter is required to have in operation at least six miles of line within six months, and all the lines by November 1, 1894. However, if by litigation the successful bidder is kept out of possession of the streets, it can have six years from the date of the signing of the contract in which to secure the streets for its lines, but it must begin work as soon as it is in possession of the streets.

Should the company holding the franchise sell or lease its property and rights to any other company, or should it make any extensions or purchase other lines, it is required by Section 23 to furnish, without extra charge, to each passenger desiring it, a transfer ticket, good on any line belonging to the company issuing such ticket.

PURCHASE, EXTENSION AND OTHER COMPANIES.

Section 24 says that at the expiration of this contract, or in case of forfeiture by reason of failure to comply with its conditions, the board of public works, with the approval of the council, may order an appraisement of the company's property and purchase the same at that value. One of the appraisers shall be selected by the mayor, one by the circuit judge and the third by the company.

If it be deemed desirable by the city to have constructed additional lines on streets not occupied by tracks of the company, Section 25 provides that the city shall notify the company to build the same; and should the company not notify the city within thirty days that it will build the lines as directed, or having notified the city, should it not within twenty days thereafter begin work, and should it not complete the work within reasonable time to be fixed by the council and board, provided no work be required between December 1 and March 15, the board and council may grant to other persons the right to build said lines. And the said grant shall confer upon said other individual the right to run over the tracks of the party of the second part within the territory bounded by Mississippi, Alabama, South and Michigan streets, for the use of which the party of the second part shall be paid on a wheelage basis, and in addition thereto a percentage of the cost of that portion of the lines used, a pro rata of the cost of the repairs and maintenance and damage to business of the party of the second part. In case of disagreement arbitration is provided for between the party of the second part and the other company. And such new line granted and built as aforesaid—no matter by whom operated—shall be operated with the right of transfer to or from all cars of the party of the second part and said new line in the same manner and under the same conditions as are provided for transfers of passengers for lines and cars of the party of the second part. The pro rata amount of the fare of such transfers due to either of said companies shall be determined by the companies — they failing to agree, the differences shall be referred to experts. If the party of the first part, after having directed the party of the second part to build any new line as hereinbefore in the section provided, and the territory along said proposed line has one-half of the lots built upon, and two-thirds of the length of said proposed line is at least two squares distant from any other parallel street car line, and the party of the first part has failed to secure the building of said lines by the means hereinbefore provided in this section, then and in that event the party of the first part may again notify the party of the second part to build said line, and on the failure or refusal of the party of the second part to begin said line as aforesaid within thirty days thereafter, or upon the failure of the party of the second part to complete the same within a reasonable time thereafter, said time to be fixed by the board of public works and common council of said city, then in case of failure or refusal in either of such cases the party of the second part shall pay as liquidated damages to the party of the first part the sum of $25 a day for each and every day that said work remains uncompleted after the expiration of the time fixed for its completion by the said board and common council, and the bond provided herein to be given by said company shall be made to include, and shall include, as one of its conditions, the payment of such damages.

The company shall operate its lines, Section 26 provides, in conformity with laws and ordinances.

BOND REQUIRED.

Section 27 provides that any company, before exercising any of the rights granted, shall execute to the city a bond of $100,000, conditioned that the company shall pay to the city any money that has been paid by the city because of any work done that under this agreement is provided to be done and paid for by the company on the demand of the city, and said bond shall be renewed from time to time upon the demand of the city.

FORFEITURES.

Section 28 says that in case the company violates any of the terms or obligations of the charter, all privileges granted shall then be subject to immediate forfeiture, and shall revert back to the city, and the contract shall become null and and void, except where different penalties are provided in the agreement; and in such event the city shall have the right to remove the company's poles, rails, tracks, etc., and a right of action for breach of contract shall immediately accrue upon the bond of the company for any injury or damage arising out of this breach of contract.

Section 29 provides that to each of the terms, conditions, stipulations and requirements of this contract the board of public works, representing the city of Indianapolis, the party of the first part, and the ———, the party of the second part by its duly authorized officers and representatives, fully agree and bind themselves, their successors and assigns.

COMPETITION IN ASPHALT PAVING.

WASHINGTON, D. C., April 19 (Special Correspondence).—Efforts are being made to break the alleged monopoly of laying asphalt pavements in the District of Columbia. For many years the Barber Asphalt Company and the Cranford Paving Company have had no competition in the work of laying and repairing asphalt pavements here. The reason for this practical monopoly has been that no asphalt has been offered which it is believed could equal the quality furnished by the Barber company, which had obtained the concession from Great Britain to use the product of the pitch lake on the island of Trinidad. There have, however, been numerous attempts to introduce another quality of asphalt, denominated land asphalt, which the commissioners have always refused to consider because the examination by the inspectors of asphalt and cement has represented it to be somewhat inferior to the lake product.

Considerable surprise was therefore manifested at the recent opening of bids for laying and repairing asphalt pavements in this city during the coming fiscal year, when Thomas H. Thomas, of South Amboy, New Jersey, offered to furnish the necessary lake asphalt at an amount about two per cent. lower than either the Barber or Cranford companies had bid.

Little is known of Mr. Thomas, although when the bids were opened Prof. De Smedt, for many years District chemist, appeared in his behalf, and it is understood is connected with him in the business. The first question naturally asked was where the new company obtained its asphalt, for the asphalt used in laying pavements in the District of Columbia is that which is controlled exclusively by the Barber company, as already mentioned.

Some time ago an effort was made to organize a competing company, known as the Schillinger Paving Company, to lay pavements in the District with the land pitch, and although the inspector of asphalt and cements reported against the use of this material, the commissioners of the District determined to give the new contractors a trial, and awarded them a street to pave on which they were the lowest bidders, and requested the posting of a bond as a guarantee of good faith, but the bond never materialized, and the order of the commissioners was revoked, and the street in question awarded the Barber Asphalt Paving Company.

As stated, the commissioners inquired where this new asphalt came from, and the reply was that it was imported from Venezuela. The only pavements laid with this asphalt by this new company, as far as is known, were in Detroit, Michigan, but as they have not been laid long enough to judge of the wear and tear incident to heavy traffic and the weather, it is believed that the commissioners will not attach too much importance to their present condition. A sample of this asphalt will be sent to the inspector of asphalt and cements for investigation and report.

Immediately upon receiving the bid of Mr. Thomas, the District Chemist was dispatched to South Amboy, New Jersey, where the works of this company are located, for the purpose of obtaining samples and examining their plants. Captain Fiebeger has since returned, and reported that he found that Mr. Thomas has four stills in operation for refining the lake asphalt. He has also a large quantity, amounting to about 700 tons of the refined article, already in barrels. The samples which Captain Fiebeger brought with him will be at once subjected to a rigid test, and if the asphalt equals the Barber article the contract will undoubtedly be awarded to the new contractors, who have underbid the Barber and Cranford Companies. There is about $150,000 involved in the matter, and the outcome of these tests will be watched with a good deal of interest.

DESTRUCTION OF GARBAGE.

The National Sanitary Company, which has the contract for removing the garbage of this city, put into operation on the 19th their crematory for incinerating garbage. For this work Congress recently authorized the commissioners to pay 50 cents a ton. Major Ferguson, president of the company, several days prior to the commencement of the plan, requested the commissioners to appoint a representative of the District Government to supervise the weighing of the garbage delivered at the furnace. He also inquired what arrangements the commissioners would make with reference to the contract of destroying the garbage. The commissioners replied that they were not prepared to make any permanent arrangements for the purpose, but that they would allow the National Sanitary Company to destroy the garbage, with the understanding that said company would take the chances of having an interpretation of the law in favor of paying for the work done under this tentative understanding.

The Sanitary Company is now carrying out the garbage contract originally let to Mr. Clark. Lately it has been able to gather only 35 tons of garbage daily. It is highly probable that the amount it will collect, when paid 50 cents per ton for incinerating, will be considerably enlarged.

A NEW SYSTEM OF STREET SWEEPING.

The commissioners of the District have decided upon a complete reorganization of the street sweeping department, and on the 15th instant new systems and new methods were introduced in the cleaning of Washington streets. For some time past the subject of street sweeping has occupied the attention of the commissioners. They believed that the hundreds of complaints that came in concerning the condition of the streets in all sections had some foundation, and after considering the matter a short time decided that the trouble lay in the system of inspection and the methods of sweeping. One of the greatest defects was in the inspection of the work. All of the inspectors were on an equal footing, and one refused to take orders from another. This complicated matters and brought about a condition of affairs in the street sweeping department that was not desirable and not conducive to the public interest. To remedy this matter the commissioners will, upon the reorganization of the department, appoint one inspector and make the other inspectors his assistants. New schedules will be made out, and the superintendent of street sweeping will be ordered to enforce a strict compliance of the contract.

ON A TOUR OF INSPECTION.

A delegation consisting of thirty-seven city officials and prominent business men of Detroit, Michigan, visited Washington recently on a tour of inspection for the purpose of examining municipal improvements that have been made in Washington and are being made. It was their idea to visit a number of important cities and profit by the experience of others in the betterment of their home city of Detroit. While here, they inspected our conduit system, for they proposed placing all of their wire underground in Detroit. They also examined our cable and electric roads, our school system, illuminating plants, and in fact all other points of municipal interest. The delegation was headed by Mayor H. S. Pingree, and included the board of aldermen, the president of the board of public works and the heads of the different city departments. A. I. P.

PAVING BRICK IN HARTFORD, CONN.

The twenty-first annual report of the street commissioners of Hartford, Conn., George G. Sill, Chas. H. Northam, William E. Cone, James Burns, James U. Trainor, and Charles S. Davidson, states that after a careful investigation of the merits of granite, asphalt and brick as street paving materials, it was decided to try brick and Pratt street was paved with this material. They say: "The work was duly completed in the best manner, and it presents a clean and smooth surface, and has become a desirable street for heavy and light vehicles. So far it has met our hopes and expectations. If, after further wear, it continues sound, level and unbroken, we shall think we have found a good quality of paving. The freight on these bricks was greater than the cost of the bricks. It would seem that when clay is so abundant as in this vicinity similar bricks might be made here, and supplied at one-half the cost of those used."

ENGINEERS AT THE WORLD'S FAIR.

Notice is given by the committee that the reception rooms and office of the general and executive committees of the Associated Engineering Societies of the United States and Canada, and of the general committee of the World's Congress Auxiliary on the International Engineering Congress, on and after May 1st, 1893, and until the close of the World's Columbian Exposition, will be at No. 10 Van Buren street, Chicago. All communications after May 1st should be addressed to, or to the care of, Mr. Max E. Schmidt, secretary. Visiting engineers may have their mail thus addressed. The committee rooms of the Associated Societies at the exposition will be situated in the southwest corner of the gallery of the Mines and Mining building, where the secretary or some of the staff will be present during the Exposition to meet visiting engineers.

NEED OF BETTER SEWERAGE AT LOUISVILLE.

A sanitary survey of Louisville, Ky., has been completed by Mr. Rudolph Hering, who reports the death rate as being from 18 to 20 per 1,000, much of which is due to typhoid and other preventable diseases. He recommended the extension of the sewerage system; only one-third of the houses adjacent to present sewers being connected with them. The water supply from the Ohio river is not even suspicious, but the water from wells is condemned. Intercepting sewers and the improved final disposal of the sewage are recommended.

RELATIVE COST OF BRICK AND GRANITE PAVEMENTS.

Mr. George B. Fleece, commenting on statements in the recent annual report of City Engineer Meriwether, of Memphis, says:

"Maj. Meriwether says a brick pavement will last, without repairs, under a traffic of 40 or 50 tons per square foot, about 8 or 10 years, but how much longer, he does not state. It is fairly presumable, however, that the life of a pavement that required no repairs in 10 years would extend to at least 15 years before final disruption. He estimates the life of granite, under heavy travel, at 15 to 20 years. We will assume that the city engineer is correct, putting the life of granite pavement at 20 years and brick at 10 years, and figure up financial problem involved.

Original cost of one mile granite..	$84,000
Interest on cost for 20 years.......	100,800
Total cost in 20 years.........	$184,800

Original cost of one mile brick....	$47,000
Interest on cost for 20 years.......	56,400
Relaying at 10 years, at $1.50 per yard..........................	28,500
Interest on cost of relaying for 10 years..........................	17,100
Total cost in 20 years.........	$149,000
Balance in favor of brick..........	$35,800

"This balance in favor of brick would pay for laying a new pavement, thus extending the life of a brick pavement to 30 years—or 10 years beyond the estimated life of granite, and still leave a large balance in favor of brick over granite. Now repeat the estimates foregoing upon the basis of equal durability of granite and brick, placing both at 15 years, and the problem works out as follows:

One mile granite, original cost....	$84,000
Interest on cost for 15 years.......	75,600
Total cost in 15 years.........	$159,600

One mile brick, original cost......	$47,000
Interest for 15 years..............	42,300
Total cost in 15 years.........	$89,300
Balance in favor of brick,...... ...	$70,600

"A surplus fund, the interest upon which, at 6 per cent. would largely exceed the cost of perpetual renewal of brick pavement.

"If, then, brick will last 15 years, it is far cheaper and better than granite, even if granite should last forever. It is the opinion of many who may be fairly considered authorities that brick will wear longer than granite."

FIR BLOCK PAVING IN TACOMA, WASH.

The city of Tacoma, Wash, is about to spend $72,000 on a fir block pavement on Pacific avenue. The entire pavement is to be 10½ inches in thickness. Of this, the lower six inches is to be of concrete, with the surface floated and smoothed with cement mortar. This will give a uniform surface on which to lay the blocks. The cement used in the concrete is to be of a tensile strength of 250 pounds to the square inch. Upon the concrete thus prepared wooden blocks 4½ inches thick are to be placed, the grain being vertical. The wood is to be taken from fir-butt logs, and the blocks will be 3 inches wide and 7 to 10 inches in length. A space three-eighths of an inch is left around each block. These spaces are to be run to a height of one-half inch with tar and asphalt. This is to bind the block to the concrete. Above this the crevices are to be filled with a cement grout. The specifications follow very closely the ones which have been so successfully used of late years in London and Paris.

DIRECTOR WINDRIM'S WORK.

Director of Public Works Windrim is pushing the paving of alleys in Philadelphia with asphalt in place of cobblestones. He fears that if cholera should reach this country this year there would be much difficulty in keeping the alleys of his city sufficiently clean. He is also making war on the street cleaning and garbage removing contractors, one of whom he has fined $5,000 for neglect of duty, making the fine $5 for each well-founded complaint from a householder. He will hereafter increase this fine on a sliding scale of $5 for each raise. His methods ought to prove effective.

RAPID TRANSIT BRINGS PROSPERITY.

As an example of what rapid transit facilities will do for thickly settled communities, it is interesting to note the effect of such facilities in Pittsburg, Pa. In the 19th, 20th and 21st wards of the city during the four years of 1889–92, there were erected 3,181 buildings at a cost of $6,910,838.50, while in the preceding eight years (1881–88) only 1,624 buildings were erected in the same wards at a cost of $2,945,608.37. Not only has the number of buildings increased, but the style has greatly improved, the average cost in 1887 having been only $2,040, while in 1892 it was $2,327.

SCARCITY OF PAVING BRICK IN THE WEST.

The annual report of William Steyh, city engineer of Burlington, Iowa, states that during last year the paving of streets there comprised 26,890 square yards, costing $49,307.59. He complains that much work has been delayed there by a scarcity of paving brick.

WATER USED IN PHILADELPHIA.

The average daily water consumption in Philadelphia for 1892 was 163,801,600 gallons, or about 160 gallons daily per head of population. The pumping capacity will be increased this year by the addition of a 20,000,000-gallon pump at the Spring Garden station, a 15,000,000-gallon pump at Frankford station and one 12,000,000-gallon pump at Roxborough. A new reservoir at Queen Lane is to be built at a cost of $1,159,591.

SOME RECENT INVENTIONS.

A Side Rail for Suspension Bridges, by Edwin G. Runyon, Pilot Point, Texas, consists of the necessary beams and floor cables, a casting on the ends of the beams having horizontal boxings through which the cables pass, arms on the castings, cross-bars secured to the castings having apertures in their ends, seats fitted in the apertures, saddles on the columns, a hand-rail, and diagonal truss cables, extending alternately over the saddles and below the needle beams.

A Sectional Mold for Building or Paving Blocks, by George M. Graham, Chicago, Ill., consisting of a mold housing, vertical walls or sections, and a lower frame connected to a section by hinges or pivots and provided with inturned flanges, and a lower plunger provided with top and bottom flanges.

A Pipe Coupling, by Orange M. Sweet, Silver Creek, N. Y., consisting of a cylinder casing having a port or passage, a cylinder block capable of turning in the casing and having a passage adapted to register with the port of the casing and an internal cylindrical socket and a cylindrical knuckle fitted in the socket of the block and having a passage adapted to coincide with the passage of the block.

A Joint for Gas or Water Pipes, by Gordon W. Lloyd, Detroit, Mich., consisting of the abutting ends of the pipes, a folded flexible packing thereon with the fold at the joint interposed between the ends, ribs formed on the pipes near the ends, and apertured sleeves embracing the joint and overlapping the ribs at each end, forming a chamber, the ends of which are formed by the ribs, the outer wall by the sleeve, the inner wall by the pipe and a filling of cement in the chamber.

A Bridge Gate, by Henry Roessing, Chicago, Ill., consisting of a swing bridge and its abutment, a housing forming a narrow trench in the abutment, a folding gate comprising bars pivoted in the housing to swing upward on their pivots from a folded position in the housing, to extend upward in unfolded position from the housing, a rail pivoted to the ends of the bars and fitting over and closing the top of the trench when the bars are folded, and movable with the bars to form the top rail of the gate when the bars are raised on their pivots, gear mechanism on the bridge, and operating gear mechanism for the gate on the abutment in the path of the gear mechanism on the bridge, to be actuated thereby to fold the gate as the bridge is unclosed and unfold the gate as the bridge is opened.

A Bridge, assigned to Richard M. Scruggs, St. Louis, Mo., consisting of a lower member, the upper member and the underneath truss, the lower member having a vertical series of horizontal chords spaced apart from each other, the upper member being arched, and the members and underneath truss being connected at the ends and the central portion of the truss.

A Metallic Culvert, assigned to Emmons T. and Morice C. Trumbull and James B. Disbrow, Savona, N. Y., consisting of a sheet iron arch having iron braces provided at their ends with suitable notches, and strips having grooves, with converging sides, adapted to catch in the notches of the braces.

A Glass Pipe Casting Machine, by Roderic G. Guptil, Pendleton, Ind., consisting of a frame work, a mold adjustable supported thereon, a movable core connected with a plunger supported above and in line with the mold, such core adapted to be raised and lowered by means of a friction clutch mechanism supported above the framework, such mold centered and closed at its lower end by a removable pivoted plug.

A Building Block, by John Heatley, Pittsburgh, Pa., consisting of a locking projection enclosing one corner, and its faces tapered toward the opposite end.

V. H. Lockwood, Patent Att'y.
Indianapolis.

RECENT LEGAL DECISIONS.

Drainage of Surface Water Into Highway.—The owner of land adjoining a highway has no right to drain his land into a ditch in such highway by means of a drain which carries the water in a different direction from its natural flow. The statute which forbids the obstruction of highways by ditches, and authorizes the highway commissioners to fill up such ditches, "except the ditches necessary to the drainage of an adjoining farm emptying into a ditch upon the highway," allows them to fill up a drain which empties into a ditch on the highway where such drain, in order to reach the ditch, diverts the water from its natural course. Davis *v.* Comm. of Highways, Supr. Ct. Ill., 33 N. E. Rep. 58.

Damage to Street Railway by Construction of Sewer.—The location of a sewer in a city street must be reasonable, with respect to the right of a street railway the construction of which was authorized by a prior ordinance and whose property might be damaged by the construction of such sewer; and such location, if made in a part of the street occupied by the railway so as to compel it to suspend operations, and inflict great damage upon it, is unreasonable when other parts of the street are equally suitable for the sewer. But the city is not required to incur any additional expense by reason of having authorized the building of such road. Clapp *v.* City of Spokane, U. S. Circ. Ct., D. Washington, 53 Fed. Rep. 515.

Liability of City for Damages from Street Improvements.—A city, in opening a street, took property on which was located one-half of a double brick house, the other half of which was owned by one other person; and the latter half of the building was greatly damaged. As it was thought no compensation could be allowed the owner, because none of his property was actually taken, the city council requested the legislature to pass an act, authorizing it to make compensation, which was done. While the bill was pending in the legislature, the owner of the property made a contract with the city by which it sold him the portion of the building taken, and he released it from all claims for damages; proceedings by the owner, under the act, to compel the city to make compensation, should not be stayed because of such contract, it appearing by the affidavits filed on his behalf that he signed the contract on the assurance of the corporation counsel that he could procure a small strip of land, left between his half of the building and the street, so as to restore his building to a proper condition, and that he was unable to do so; and that the expense of taking down and removing the property sold him by the city was equal to its value; but, if there was any excess of such value over the expense, he should be compelled to allow it in reduction of damages. In re Elmwood Ave., 21 N.Y. Sup. 592; Supr. Ct. of Buffalo.

Liability of Owner for Paving Street.—Property owners are not liable to an assessment for paving a strip previously macadamized, in the middle of the street, at expense of the property. City of Philadelphia, to use of Vulcanite Paving Co., *v.* Eheret, Supr. Ct. of Penn., Jan. 30; 25 At. Rep. 888.

Mandamus to Board of Aldermen.—Where, at a municipal election, there has been no choice, and at a second election there has been no choice, and the board of aldermen order a third election on the first of the month following, mandamus will not lie at the relation of certain candidates for office to compel the board to order an election at an earlier day, as such relators have only an interest in common with the rest of the public, and are not entitled to petition in their own names. O'Brien *v.* Board of Aldermen of City of Pawtucket, Supr. Ct. of Rhode Island, Dec. 28, 1892; 25 At. Rep. 914.

Negligence in Maintaining Defective Bridge.—Where a child fell through a bridge into a canal, in consequence of negligence in permitting an opening to remain unguarded, and without contributory negligence on the part of its parents, and the father, in an effort to rescue the child, plunged into the canal, and both were drowned, the death of both must be attributed to negligence in maintaining the unsafe bridge. Gibney *v.* State, Court of Appeals of New York, Jan. 17, 1893; 33 N. E. Rep. 142.

PERSONALS.

Mr. D. M. Starr has been elected city surveyor of Litchfield, Ill.

Mr. L. E. Chapin, of Canton, Ohio, is engaged in preparing a sewerage system for Alliance, Ohio.

Mr. Harvey Linton has been re-elected city engineer of Altoona, Pa.

Mr. H. M. McIntosh has been elected city engineer of Burlington, Vt.

Mr. T. L. Kennerdell has been elected city engineer of Franklin, Pa.

Mr. Joseph P. Phillips has been appointed city engineer of Scranton, Pa.

Mr. E. B. Baker has been appointed city engineer of Gloversville, N. Y.

Mr. G. W. Woodward has resigned his position as city engineer of Hastings, Neb.

Mr. Rudolph Hering has been engaged to design a system of sewerage for Charlottesville, Va.

Mr. James B. Gass has been re-elected city engineer and superintendent of sewers at Fort Smith, Ark.

Mr. R. A. Bryan, who has been city civil engineer of Portsmouth, Ohio, for thirteen years, has resigned.

Mr. L. W. Burt, city surveyor of Hartford, Conn., has had his salary raised from $2,000 to $2,500 per year, by a unanimous vote of the council.

Mr. William Steyh, of Burlington Ia., has been re-elected city engineer. This is his eleventh year of service with the city.

Mr. Lewis Kingman has been re-appointed city engineer of Topeka, Kan., for a term of two years. He has already served four years.

Mr. W. T. Sanborn, who was for some time connected with the Dover (N. H.) Gas Light Company, has retired from the gas business.

Dr. F. P. Vandenburgh, of the Vandenburgh Laboratory of Chemical Industry, Buffalo, N. Y., has returned from a professional examination of the asphalt deposits in Trinidad and Venezuela.

Mr. John A. Cabot, formerly with the Cincinnati Edison Company, was appointed city electrician of Cincinnati. He takes the place of Mr. Rob MacKie, who has accepted the position of chief engineer of the "C. & C." Electric Motor Co.

Maj. J. W. Howard will be in charge of the exhibit of the Barber Asphalt Paving Company in the department of mines and mining, at the Columbian Exposition. He is also to make tests and records of traction on different roads and pavements for the Department of Agriculture.

LETTERS FOR THE PUBLIC.

SLAG FOUNDATIONS UNSATISFACTORY.

To the Editor of Paving and Municipal Engineering:

SIR—Noticing in your April number, page 242, the statement that concrete was not used as a foundation for brick pavements in Youngstown and other cities named, but that slag from gas works and broken stone is considered better, I beg permission to correct the statement so far as Youngstown is concerned. Slag from blast furnaces was used here at one time, but it gave unsatisfactory results and its use has been abandoned for foundations and concrete substituted in its place. We regard a first-class foundation as essential to the life of a brick pavement.

F. M. Lillie, City Civil Engineer.
Youngstown, O., April 14, 1893.

WORKS ON SEWERAGE AND SEWAGE DISPOSAL.

To the Editor of Paving and Municipal Engineering:

SIR—Please give me the titles of some works on sewerage and sewage disposal. *J. C. B.*
Sacramento, Cal.

A few references to such works, cited by Mr. Wolcott C. Foster, are the following:

Gray (Samuel M.), Report on Sewerage to City of Providence, R. I. (Describes European practice.) An excellent work.

Adams on Sewers and Drains.

Staley and Pierson's Separate System of Sewerage.

Broom on Sewage Disposal.

Phillips on Sewage.

Tidy, Treatment of Sewage.

Latham's Sanitary Engineering.

Coefield, Sewerage and Sewage Utilization.

Waring, Sewerage and Land Drainage.

Baumeister, Cleaning and Sewerage of Cities.

Flynn, Hydraulic Tables for Sewer Pipes, etc.

Robinson on Sewage Disposal.

Crimp in Mins. Proc. Inst. C. E.'s, Vol. XXXVIII, p. 178.

A GOOD PLACE FOR A PAVING BLOCK PLANT.

To the Editor of Paving and Municipal Engineering:

The matter of paving our streets is being agitated, and suitable ordinances have been passed for paving under the special assessment plan. It costs us thousands of dollars each year to keep our roads in repair. They are clay, and being situated near high bluffs, they wash badly in every hard rain. We have the fire clay, soapstone, shale and brick clay at hand for making brick of any kind. We have only one small brick plant here in the city making a few building brick each year. This would be an excellent location for a large brick or fire-proof construction plant, and if the streets are paved this season, as undoubtedly some will be, it will make some work for the brick business.

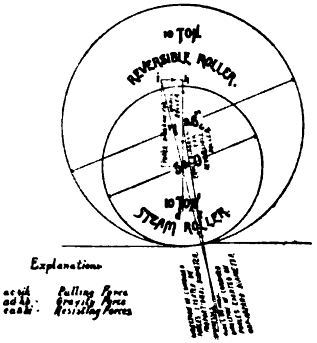
C. L. Stinson, City Clerk.
Marseilles, Ill., April 9, 1893.

MACHINERY AND TRADE.

POPE'S REVERSIBLE ROLLER.

It is a popular theory that it is weight in a roller that produces compactness in road building. Sufficient importance is not attached to the diameter of the roller. In combating this theory, the claim is made that the trouble with some of the steam rollers is due to the fact that, with an average of five feet in diameter, they carry an average load of 15 tons. The argument is made against this that larger proportional diameter has more bearing on the street than rollers of smaller diameters; thus, in one respect, overcoming the liability of stalling in soft places.

This is the claim which Mr. R. C. Pope has been making in behalf of his reversible roller and he offers figures to demonstrate that a 7-ton reversible roller is more efficient than a 12-ton steam roller, as follows: A 12-ton steam roller carries 12 tons on 92 lineal inches of bearing, making 260 pounds per lineal inch, while a 7-ton reversible roller carries 7 tons on 60 lineal inches, making 233 pounds per lineal inch.



The accompanying drawing illustrates the comparison that he aims to make, exhibiting a diagram of forces showing the gravity, resistant and pulling forces, the two latter having been reduced to a minimum, and the gravity force increased. The diameters of reversible rollers are calculated in reference to this principle and represent 333⅓ pounds per one inch diameter. In connection with this showing, it is argued that less stone and thin layers with more rolling make better roads at less cost.

Mr. Pope's rollers have come into quite general use. Twenty-two of them are owned by the city of St. Louis, and among the places where sales have recently been made are Evansville, LaFayette, Ind., Louisville, Ky., Chicago, Quincy, Ill., and Indianapolis, where experience with it is reported to be quite satisfactory. One of the advantages of his roller is that it is controlled by one shaft. It is widely known as a foundation roller and is also very largely used in the construction of brick paved streets, having been used in probably seventy-five per cent. of such streets.

OIL ENGINES FOR STREET CARS.

An application of the gas or oil engine to the propulsion of street cars is to be found in Chicago, where the Yerkes syndicate are experimenting on a practical scale with the Connelly motor. An oil engine company at Dessau, Germany, is offering to equip a line of street cars at Erfurt in the same empire. At that city the horse cars are to be given up, and it was intended to ask the Thomson-Houston company to erect an overhead electric line until the oil engine proposition was brought forward. It is very doubtful whether a system of cars driven by oil engines can ever be worked as cheaply as the overhead electric system, on account of the weight of the engine and tank of oil that necessarily forms part of the load of each car. At the present time a commission is investigating the relative merits of the overhead electric and oil engine systems as applicable to the Erfurt street lines.

The Connelly motor was tried for a time in Elizabeth, N. J., with very unsatisfactory results. It is said, however, that improvements have been made in the motor since then.

NOTES.

Another new catalogue of forty pages, handsomely printed and freely illustrated, has just been issued by J. W. Penfield & Son.

A new company has organized at Anderson, Ind., to manufacture vitrified paving brick. Messrs. Goff & Slayback are the promoters. The company will buy the brickyard of Jones & Clemans, of that place, and will convert the yard into a paving brick factory.

IMPROVEMENT AND CONTRACTING NEWS

PAVING.

CONTEMPLATED WORK.

More paving is talked of at Decatur, Ill.

Paving is talked of at Chillicothe, Ohio.

Crawfordsville, Ind., is about to begin a system of paving.

Oskaloosa, Iowa, is discussing the question of more paving.

There is talk of paving West Eleventh street, Anderson, Ind.

Chestnut Hill avenue and Boylston street, Boston, are to be widened.

H. C. Schultz, city clerk of Waterloo, Iowa, writes that that city contemplates paving.

A fine driveway six miles long will probably be built between Allegheny City and Perrysville, Pa.

The question of paving the principal business streets is being discussed to some extent at Peru, Ill.

Emery D. Irelan, city clerk of Atlantic City, N. J., writes that the city contemplates paving at an early date.

W. A. Gray, of Danbury, Conn., writes that the city may do some granite block paving in the near future.

E. B. Parsons, city engineer of Fond du Lac, Wis., writes that paving on various streets is contemplated this season.

F. W. Allison, clerk of Salem, Ohio, writes that petitions are being circulated, and it is probable that a number of streets will be paved this season.

Muscatine, Iowa, contemplates paving Second and Third streets with brick. The commercial club has been securing estimates of the probable cost.

L. C. Kelsey, clerk of Elyria, Ohio, writes that some of the streets of that place will be paved with brick this summer. The contracts will not be let until June.

Muskingum county, Ohio, is preparing to take the lead in the experiment of paving county roads with paving brick. It is proposed to pave the river road south from Zanesville to the first bridge, a distance of four miles, half the money to be raised by private subscription and the other half to come from the township and county.

J. M. Kennedy, clerk of Aurora, Ill., writes that a considerable amount of paving, consisting mostly of cedar blocks, will be put down in that city this season.

Ed Hough, city clerk of Sedalia, Mo., reports resolutions for paving on about a dozen different streets. The outlook is good for a great deal of street improvements this season.

There is a movement on foot among the residents of Arlington avenue, Des Moines, Iowa, to put a top dressing of asphalt on the brick pavement from State street to the river. The residents also intend to beautify the parking by planting flowers the whole length of the avenue.

CONTRACTS TO BE LET.

Fourth street, Williamsport, Pa., is to be paved.

A mile of brick street is to be constructed in Covington, Ky.

The business streets of Riverside, Cal., are to be paved at once.

Rochester, N. Y., will soon want bids for Medina stone and asphalt paving.

Plans have been prepared for paving on about twenty-five streets of New Orleans, La.

About twenty miles of macadam roadway will be constructed near Wyandotte, Mich.

City Engineer Culver, of Salem, Oregon, has prepared plans for paving on various streets.

Paving in Charleston, Ill., is now an assured thing. The council will advertise for bids.

East Bridge street, Plainfield avenue and Scribner street, Grand Rapids, Mich., are to be paved.

Parts of Scott, State, Greenup and Garrard streets, Covington, Ky., are to be paved with brick.

The city engineer of Salt Lake City, Utah, has prepared estimates for paving on a number of streets.

E. E. Forbes, city auditor of Clinton, Ia., writes that bids will be opened May 9 for two blocks brick paving.

Fayette street, from Market to East streets, Washington, Ohio is to be graded, curbed and paved with brick.

A number of residence streets will be paved next summer in Sioux City, Iowa. Brick will probably be chosen.

The court has authorized the proposed increase of the debt of Jenkintown, Pa., $30,000 to macadamize the streets.

An ordinance has been passed for the extension of Jackson Boulevard, Chicago, through the Garfield driving park.

The business portions of Colorado street and Raymond and Fair Oaks avenues, Pasadena, Cal., are to be asphalted.

Moliter street and McLean avenue, Cincinnati, will be paved with brick. Granite blocks will be laid on Butler street.

Albert E. Andrews, city clerk of Warren, Ohio, writes that proposals will be received, May 8, for paving with brick, granite, asphalt or asphalt block, Mahoney Ave. and Main St.

A fifty-foot roadway on West Third street, Williamsport, Pa., will be paved, probably with asphalt. There will be a seven-foot sidewalk and an eight-foot parkway on each side of the road.

Walnut, Fourth, Fifth, Sixth, Seventh, Eighth, Ninth, Tenth and Eleventh streets, Des Moines, Iowa, will be paved with brick except the distance between Court avenue and Vine, which in each case will be paved with granite.

Geo. T. Day, city clerk of Union City, Ind., writes that declaratory resolutions have been passed providing for the grading, graveling, curbing and sidewalking of Walnut street from Division to Pearl, and of High street from Hickory to Pearl.

Franklin, Pa., is agitating the street paving question. There is a demand for the repaving of the north and south ends of Thirteenth street, and South Park street entire, this summer. The city engineer has been instructed to furnish estimates.

J. J. Matt, of Far Rockaway, N. Y., reports that a resolution has been passed for the macadamizing of about forty-two miles of highways in the town of Hempstead, at an average cost not to exceed $10,000 per mile, the macadam not to exceed eighteen feet in width.

John Macdonald, clerk of Brazil, Ind., writes that the city council will receive bids until June 20, for sawed stone flagging sidewalks, two inches thick, for each side of Lambert street, from Main to Ridge streets, a distance of about 1,200 feet, and for each side of Franklin street, for a distance of about 1,200 feet; also, for finishing unsawed stone flagging sidewalk four inches thick, on each side of Meridian street.

That the sanitary condition of Philadelphia may be better, the city will pave with sheet asphaltum the small streets of the city. The sections to be paved are divided into eight districts and proposals asked for separately, in order that the work may be done as speedily as possible.

J. W. Sedgwick, city engineer of Pasadena, Cal., reports that he has been instructed to prepare specifications for paving with asphalt portions of Fair Oaks avenue, Raymond avenue and Colorado street. Contract for grading, guttering and curbing about one-half mile of North Raymond avenue has been let to Mushrush & Carson at 87½ cents per lineal foot. Resolutions have been passed for cement sidewalks on various streets.

The Indianapolis Board of Public Works will receive bids for paving with asphalt: Talbot avenue, from Fourteenth to Seventeenth streets, May 12; Broadway, from St. Clair to Seventh streets, May 12; Pennsylvania street, from Virginia avenue to Maryland street, May 12; Arsenal avenue, from Washington to Michigan streets, May 19; Shelby street, from Coburn to Pleasant Run, May 19; Walnut street, from Meridian to Tennessee streets, May 15. Bids for brick pavements on various streets will be received on May 3.

CONTRACTS AWARDED.

Henry S. Hallwood has been awarded the contract at $1.79 for paving with Hallwood block 66,000 square yards of streets in Evansville, Ind.

The Department of public works of New York City has awarded numerous paving contracts to the Barber Asphalt Paving Company at a total of $244,731.75, and to the Sicilian Asphalt Company at $109,236.18.

The Pacific Paving Co., of Utah, have the contract for paving West Temple street between South Temple and Fourth South streets, Salt Lake City. Their bid was: Curbing, 5,000 feet, at $1.00, $5,000; flagstone, 6,000 feet at 73 cents, $4,380; stone blocks, 6,000 square yards at $3.15, $18,900; asphaltum, 15,000 square yards at $2.97, $44,550; total, $72,830. The other bidders were the Culmer-Jennings Paving Company and Ryan & Griffin.

The following contracts for paving in Dayton, Ohio, have been let: Bridge street, Trinidad Asphalt Company, $10,506; Brown street, from alley south of Buckeye street to Oak street, Berry & Davis, Bellaire, Ohio, Canton metropolitan block, $19,377.50; Brown street, from Fifth street to alley south of Buckeye, Berry & Davis, Canton metropolitan block, $22,186.50; Brown street from Oak street to Fairground avenue, M. G. Cain & Co., East Clayton block, $20,364; Fourth street, from Jefferson street to the canal, Trinidad Asphalt Company, $1,119.14; Kenton street, M. G. Cain & Co., Medina stone, $5,395.75.

A contract for paving with asphalt in Erie, Pa., has been awarded to the Erie Paving Company at $3.00 per square yard with a guarantee for ten years. The Trinidad Asphalt Company, of New York, bid $3.15.

SEWERAGE.

Saginaw, Mich., will spend $57,925.26 for sewers this summer.

Portland, Oregon, is now building the largest sewer on the Pacific coast. It is being constructed of brick and stone, on E. Alder St. It will be 2½ miles in length and cost $116,512.17.

CONTEMPLATED WORK.

A system of sewers will be built at Brunswick, Me.

The council of Scottdale, Pa., has voted to ascertain the cost of a sewerage system.

The sewerage system question is being agitated by the people of Flemington, N. J.

The Chillicothe, Ohio, board of trade is agitating the question of a sewerage system.

The question of sewerage is uppermost in the minds of the citizens of Monticello, Ind.

The great need of a good sewerage system for Plainfield, N. J., is being discussed there.

It is estimated that the total cost of sewering district A, Sioux Falls, S. D., will be $317,000.

Glenwood Springs, Colo., is agitating the question of a better sanitary condition and a sewerage system.

The question of sewerage is being discussed at Fort Dodge, Kan. The bids will probably be wanted soon.

The city of Colorado Springs, Colo., proposes to issue $35,000 in bonds to extend the city sewerage system.

The sewer committee of Cohoes, N. Y., has recommended the construction of a main sewer across the city.

The town committee of Moorestown, N. J., has recommended a system of sewers to cost from $40,000 to $50,000.

The street commissioners of Malden, Mass., have requested that $150,000 be appropriated as soon as practicable for sewers.

Mr. J. W. Howson is president of the sewer commission recently organized at Cazenovia, N. Y., for the purpose of having a careful survey made and having the question of sewers submitted to the people.

The citizens of Jamestown, N. D., especially the business men, are agitating the question of a sewerage system for the town.

J. S. Smith, clerk of Canandaigua, N. Y., writes that that village contemplates building several short sewers during the season.

A committee has been appointed at Paso Robles, Cal., to investigate the question of a sewer system and the proposed issue of sewer bonds for about $60,000.

F. W. Puderer, clerk of Belleville, Ill., writes that the city council has closed a contract with Engineer Edward Fladd, of St. Louis, Mo., for plans of a complete sewerage system for the city.

St. Louis, Mo., has 62 miles of main sewers and 276 miles of lateral sewers. They have cost $7,628,383.31. The city now has in contemplation the turning of the River des Peres into a sewer, from its mouth to where it leaves the city boundaries on the northwest. As it is one of the crookedest streams that flows, the distance is 37 miles, and the total cost of the work will reach $13,000,000. It will afford drainage for every portion of the unsewered part of the city.

CONTRACTS TO BE LET.

Red Jacket, Mich., will have a $30,000 sewer system.

The sewer system at Davenport, Iowa, will be extended.

Plans have been prepared for a $30,000 sewer in Akron, O.

Durango, Colo., has decided to construct a sewerage system.

Numerous sewer main extensions have been authorized at Rochester, N. Y.

The estimated cost of the proposed sewerage system at Derry, N. H is $55,579.97.

A stock company has been formed to construct a sewerage system for Mobile, Ala.

The city of Creston, Iowa, will have a sewerage system built along its streets and alleys.

Specifications and estimates have been prepared for the west-side sewer at Rochester, N. Y.

Redwood Falls, Minn., has prepared plans for a sewerage system estimated to cost $80,000.

Plans have been adopted for a sewer system for Salinas, Cal., estimated to cost about $30,000.

Sealed bids have been advertised for the work of constructing a masonry sewer about 40,000 feet in length at Salt Lake City, Utah. It will be from 42 to 64 inches internal diameter.

An appropriation of $15,000 has been voted for extending the sewer system of Westfield, Mass.

Plans are being prepared for a sewer system about eighteen miles in length in Charlottsville, Va.

The sewer committee of Hamilton, O., has authorized the construction of numerous additional sewers.

H. K. White, city clerk of Benicia, Cal., writes that the city wants bids for eight blocks of 10-inch pipe sewers.

The council of Council Bluffs, Ia., is considering plans and specifications of the city engineer for important sewer work.

A. B. Phillips, clerk of Ashtabula, Ohio, says the council has determined on additional sewerage to the amount of $22,000.

J. M. Kennedy, city clerk of Aurora, Ill., writes that about nine miles of sewers will be built in that city this fall or next spring.

F. W. Dalrymple, city engineer of Bradford, Pa., writes that about one mile of new sewers will be constructed during the season.

A map and plan of a permanent system of sewerage for Cortland, N. Y., has been prepared and approved by the state board of health.

Sealed bids will be received until May 16, 1893, for constructing sections A, B, C, D and E of the Lick Branch sewer at Nashville, Tenn.

The citizens of Ann Arbor, Mich., voted in favor of a sewerage system and will now bond for $30,000 and the main sewer will be built at once.

F. W. Allison, city clerk of Salem, Ohio, writes that a two-ring brick sewer, 2,500 feet long, will be built at once to serve as a trunk line sewer.

H. O. Rupert, city auditor of Fargo, N. Dak., writes that the city will receive bids until May 8 for the construction of additional sewerage.

Marinette (Wis.) people have voted to issue $60,000 worth of bonds to complete the sewer system and accomplish other important improvements.

Plans have been prepared for 10,000 feet of eight to twenty-four-inch pipe sewers, average cut nine feet, in Watertown, N. Y. Bids will soon be called for.

Ordinances providing for the construction of the following sewers at Cleveland, Ohio, passed the city council: Harlem street, between Willson avenue and Kirtland street; Sheriff street, between Bolivar and Eagle streets and Bright street, between Fountain and Noble alleys.

Menasha, Wis., is to have a sewer to extend from Lake Winnebago to Lake Butte des Mortes. It will be about a mile in length and will cost about $12,000.

The mayor of Reading, Pa., has signed ordinances providing for a complete system of sewerage, and appropriating $100,000 for a pumping station and disposal plant.

Plans have been prepared by F. Danforth for a system of six to twelve-inch pipe sewers. The council is considering an appropriation of $10,000 for the construction.

E. B. Parsons, city engineer of Fond du Lac, Wis., writes that the city is advertising for bids for 1,460 feet of 10-inch sewer in Ninth street and 420 feet in Fifth street.

The city of Tampa, Fla., is taking the initiatory steps to establish a sewerage system. Col. Geo. E. Waring is to make proper inspection of the facilities for proper drainage.

A sewer will be built in Clark street, Youngstown, Ohio. It will begin at the northerly end, near Mahoning river, thence southerly to Mahoning avenue, connecting with Mahoning avenue sewer.

The municipality of Cadiz, Spain, offers a premium of 30,000 peseta ($6,000), to the author of the best plan for a proposed sewerage system. The competition remains open until December, 20, 1893.

The finance committee of Jersey City, N. J., has approved the plans for the extension of the Ravine road sewer to the Hudson river; total length 6,700 feet, of which 5,600 feet will be 48-inch iron pipe; estimated cost, $84,326.

A resolution has been adopted by the city council of Toledo, Ohio, ordering the construction of a cylindrical brick sewer, twenty inches inside diameter and four inch shell, along center line of Michigan street, from sewer in Locust street to Walnut street.

Plans have been completed for the joint district sewer on South Grand avenue, Kansas City, Mo. It will follow Grand avenue to the Westport road and the Westport road to the city limits. It will empty into the O. K. creek sewer and the estimated cost is about $20,000.

Resolutions have been adopted by the city council of Columbus, Ohio, declaring it necessary to construct a main trunk sewer, beginning at a point on the east bank of the Scioto river and where the line of Morrell avenue extending west would intersect the same; thence east on said line to the bank of the Columbus feeder to the Ohio canal, eight feet inside diameter; thence continuing in same line east to the intersection of Morrell avenue and Fourth street, seven feet six inches inside diameter; also a branch main beginning at the intersection of the above described main at Morrell avenue and South Fourth street, thence east with the center line of Morrell avenue to the center of Parsons avenue, four feet six inches inside diameter.

CONTRACTS AWARDED.

The contract has been let for a $7,800 sewer on Como avenue, St. Paul, Minn.

Messrs. Mitchell & Morgan, of Kingston, N. Y., were awarded the contract for the construction of a sewer system at Stamford, N. Y.

Christian Poock was the lowest bidder on the construction of pipe, brick and stone storm water sewers to take the place of the present Leely's ditch, which is to be filled up at Dayton, Ohio. The engineer's estimate was $53,000 and the lowest bidder was $43,862.

Mr. R. T. McDonald is the contractor who will build for the city of New Orleans a complete sewer system, to cost when completed $3,000,000. New Orleans has long been in need of a sewer system and the project is one which will require great skill in engineering as the city is extremely low.

Moulton & O'Mahoney have the contract for one of the largest and most important sections of the sewerage system at Providence, R. I. The contract provides for a sewerage aqueduct along the Woonasquetacket valley, and for a big main artery of sewers to traverse the central and tide-water districts of the entire city.

WATER-WORKS.

In Paris the drinking water used comes from the River Seine, but recently it has been recommended that the water should not even be used to sprinkle the streets, because when it dries the dirt carried in it in solution is so full of contagious germs.

New York city authorities have been strenuously working for purer water by means of a sanitary protection of the sources of supply, and the prevention of the pollution thereof by sewage and other matter tending to defile the supply. The villages in the vicinity of the Croton watershed have been visited, and many of the worst sources of pollution destroyed.

CONTEMPLATED WORK.

A water-works plant is proposed at Milan, Tenn.

The citizens of Washington, Kan., want water-works.

The water-works question is being agitated at Fayetteville, Tenn.

Figures and plans have been secured for water-works at Piedmont, W. Va. The estimate for complete works is $43,000.

Tower City, Pa., is to have a new water supply system.

Eastland, Texas, is endeavoring to secure water-works.

Plans for a water-works plant are being made for Kensington, Pa.

Gallipolis, Ohio, contemplates erecting a $60,000 water-works plant.

The city engineer of Petersburg, Va., estimates the cost of a 155,000,000 gallon reservoir at $30,000.

The water-works system at Cedar Rapids, Iowa, will be owned and operated by a non-resident corporation.

J. A. Crawford, city clerk of Benton Harbor, Mich., writes that an extra water supply, stand-pipe system, is under consideration.

The water commissioners of Binghamton, N. Y., estimate that a 6,000,000 gallon filtering plant could be put in for less than $50,000.

The water-works system at Grand Forks, N. D., will be enlarged and improved by the extension of new mains, and bids have been advertised for.

The citizens of Aurora, Ind., are now agitating the question of a water-works system. The expense is variously estimated at from $50,000 to $65,000.

The citizens of Hartford, Mich., are agitating the question of damming the Paw Paw river at that place for the purpose of obtaining water power for a system of water-works.

A goodly number of the Maryland towns are moving for new or improved water-works; among them are Frederick, Hagerstown, Cumberland, Cambridge, Crisfield and Middletown.

Water-works are contemplated at Manlius,N. Y., Rockport, Wash., Downsville, N. Y., Dothen,Ala ,Coraopolis, Pa., Mount Vernon, Wash., Spanish Fork, Utah, Mount Kisco, N.Y., Goliad, Tex., Orrville, Ohio, and Oxford, Ala.

J. W. Buchanan, clerk of Chanute, Kan., writes that the city has voted $50,000 water-works bonds. As soon as satisfactory arrangements can be made with the Santa Fe Company in regard to their taking water of the city, the bonds will be issued.

Mr. E. F. Layman, of Cincinnati, reports that the village council of Wyoming, Ohio, has adopted the Van Vranken flush tank, and has ordered the construction of a number at once. The village has contracted to furnish the neighboring village of Hartwell with water, the quantity to be not less than 100,000 gallons in each twenty-four hours.

The Apollo Spring Water Company has contracted for twenty miles of pipe to supply Pittsburgh with pure water. The vein of water that will be drawn upon was discovered by the West Pennsylvania Gas Company while drilling for gas in Westmoreland county, and flows at the rate of 1,000 barrels daily. It will be brought to the heart of the city by pipe lines, thence distributed to the houses by cistern wagons.

The Chicago water-pipe line, which was originally started to connect the World's fair grounds with the springs at Waukesha, has been completed to and connected with the reservoir at Big Bend, within ten miles of Waukesha, where, it is claimed, water identical with that at Waukesha is to be had from a spring. The supply is ample for the World's Fair grounds, and it will be turned into the main in time for the opening of the fair.

W. E. Thomas, city clerk of Roanoke, Va., writes that the city council has appointed a committee in relation to the purchase of a large spring in the north suburbs for the purpose of erecting water-works and supplying the city with water. The spring and sixty acres of land have been offered to the committee for $60,000. The committee will recommend the purchase of the same, and the issuance of $150,000 of city bonds to erect water-works. The present water supply is owned by the Roanoke Gas and Water Company.

The Blue Lakes Water Company of Alameda, Cal., has a gigantic plan on foot for the supplying of water to various interior towns and cities in the northern portion of the state. The water of the company is mainly obtained from the Blue Lakes, which lie within Alpine and Amador counties. At present every town in Amador county receives its supply of water from this company and some 100 miles of canals and ditches have been constructed and soon the company expects to be able to furnish water to irrigate the northern portion of the San Joaquin Valley. When the scheme is fully under way, power will be supplied for electric plants.

CONTRACTS TO BE LET.

Victoria, Tex., will extend its system of water-works.

The village of Buchanan, Mich., will bond itself for $50,000 for water-works.

H. W. Sturtevant, clerk of Delavan, Wis., writes that plans and specifications are being made for a system of water-works for that village.

The water-power committee of the city council of Winnipeg, Man., will receive bids until June 3 for the construction of the works necessary to make available the water power of the Assiniboine river for the use of the city.

The village of Saranac Lake, N. Y., is to add to its advantages this summer new water-works and a complete system of sewers, costing several thousand dollars.

Sealed proposals for the construction of a system of public water-works will be received by the burgess of Somerset, Pa., until May 13. The plans cover both the gravity and pumping system, with a reservoir, and bidders may bid on one or both of them.

F. W. Dalrymple, city engineer of Bradford, Pa., writes that the councils have determined to put in an additional water supply, consisting of a 60,000,000 gallon reservoir, a new 16-inch supply main five miles long, and about three miles of additional pipe.

Water-works will be built at Southampton, N. Y.; Hillsboro, Ohio; Huntingburg, Ind.; Rockport, Mass.; Buchanan, Ill.; Karnes City, Tex.; Brewton, Ala.; Rock Mount, N. C.; Richmondville, N. Y.; Tower City, Pa.; Florence, Colo.; Raymond, N. H.; Greenfield, Ind.

S. H. Finley, city engineer of Santa Ana, Cal., writes that the city clerk has been authorized to advertise for bids for sinking a ten-inch artesian well to a depth of 600 feet to furnish water for the greatly increased number of patrons of the city water-works system.

Sealed proposals will be received by the water-works trustees of Clyde, Ohio, until May 9, for furnishing 7,108 lineal feet of four-inch pipe, also special castings, valves, valve boxes, fire hydrants, etc. Bids will also be received for the construction of a well according to plans and specifications.

P. A. Kinsley, clerk of council of Renovo, Pa., writes that the council has decided to reconstruct its reservoir by grouting the bottom and sides and erecting a stone wall on top of the side grouting. The work has been placed in charge of the water committee, which has begun operations. The basin will be 190 feet long and 200 feet wide. The improvement will cost $5,000.

CONTRACTS AWARDED.

The Williamsport (Pa.) Water Company has contracted for an immense pump with a capacity of 5,000,000 gallons daily.

The contract has been let to J. B. Neely, of Chattanooga, Tenn., for building water-works at Lexington, Ky. It is one of the largest contracts of the kind ever let in the south.

George T. Day, city clerk of Union City, Ind., writes that the contract for 1,250 feet of 6-inch water main on West Division street has been awarded to the Knapp Supply Company, of that city, at seventy-two cents per foot.

BRIDGES.

Defiance, Ohio, is going to have some new bridges.

Scurry county, Texas, is to have three new bridges.

A new bridge will soon span the Penobscott river at Bangor, Me.

A $50,000 bridge is to be built over the Great Miami, at Miamitown, O.

Plans have been submitted for the rebuilding of the Bluff street bridge at Kansas City, Mo. The estimated cost is $24,000.

Contract has been let for a 120-foot span, iron bridge, to be built across the Scioto river at La Rue, Ohio.

An iron bridge will span the Sequachee river at Alley, Tenn. It will be 160 feet span and is to cost $3,840.

Sealed bids will be received by the town clerk of Marysburg, Minn., until May 13, for the construction of a stone arch bridge.

A new bridge will soon be built over Alum creek just west of Westerville, Ohio. The legislature voted $25,000 for that purpose.

Plans, specifications and bids will be received on May 15 for the construction of an iron draw-bridge over the Alabama river near Montgomery, Ala.

An ordinance to appropriate $20,000 for the erection of the Fifteenth street bridge, Tacoma, Wash., has passed its third reading in the city council.

The Bullen Bridge Company has been awarded the contract for building the West Fourth street bridge and viaduct in Pueblo, Col., for $43,900.

A petition to the board of viewers and county commissioners has been filed for a free bridge across the Ohio river at Locust street, Allegheny, Pa.

B. F. Baker, town clerk of Brookline, Mass., writes that a new bridge is to be built over the railroad on Aspinwall avenue, at a cost of from $18,000 to $20,000.

C. P. Rogers, Jr., city clerk of Corry, Pa., writes that two iron bridges will probably be built this summer. One will have a sixty-foot span and the other a twenty-foot span.

Three bridges are wanted at Ottawa, Ill.; two to be built across the canal, one at Washington and one at Mulberry streets, and the other from Madison to Congress streets.

Nelson & Buchanan, of Chambersburgh, Pa., have been awarded the contract to erect a steel and iron county bridge at Cunningham's fording, Perry county, Pa., at their bid of $2,235.

The American Bridge Co., of Roanoke, Va., has closed a contract for the erection of a railroad bridge at Charleston, S. C., to be 105 feet in length. It also has the contract for building a bridge 108 feet long over the Leon river, at Gateville, Tex.

Dean & Westbrook, of New York, were awarded the contract for building the Second street bridge at Manchester, N. H. Charles A. Bailey, of Suncook, N. H., was awarded the contract for stone work. The bridge will be 186 feet over all and cost $59,187.36.

The Minneapolis committee on roads and bridges has recommended the building of a bridge this summer over the railroad tracks on Fourth street northeast. The Minneapolis improvement company northeast has volunteered to advance the money, $11,400, which is to be refunded July 1, 1894.

A 126-foot span Howe trestle bridge, thirty-eight feet above the water, across the Black Bear river, in Kansas, was burned recently, and Mr. Cross, of Wichita, had a bridge erected so that trains passed in less than twenty hours after the burning occurred. This is claimed to be the fastest bridge building record in the world.

The Missouri River Bridge Company has been incorparated at Sioux City, Iowa, with a capital stock of $2,500,000. The company has purchased the works and franchise of the Pacific Short Line Bridge Company, now constructing a common road and wagon bridge across the Missouri river at that place, and will complete it.

The city engineer has completed the plans for the Holton street bridge at Milwaukee, Wis. The opening will be sixty-five feet wide. The draw is quite different from anything of the kind in Milwaukee. The two ends of it fold up like a jack-knife, when the bridge is opened.

The new bridge being built over the Ohio river at Wheeling, W. Va., is one of mammoth proportions and will cost nearly $1,000,000. The width will be sixty feet, thirty feet of which will be taken up by a double track through the center. On either side of this there will be a ten-foot wagon-way and a five-foot walk for foot travelers. It will have five stone piers and two stone abutments.

Another bridge is to connect New York and Brooklyn, which, when completed, will make the Brooklyn bridge seem small by comparison. Its feeders will stretch out to great distances upon the east side of New York, and its span over the river will be much longer than that of the Brooklyn bridge. It will cost $25,000,000, and the contract provides that it must be finished during the present century.

STREET LIGHTING.

Margaretville, N. Y., is asking for electric lights.

A new electric light plant is now being built at Lexington, Ill.

Holly, N. Y., has appropriated $1,100 for electric street lighting.

Electric lights are badly wanted by the citizens of Rossville, Ill.

Medina, Ohio, will vote on $15,000 bonds for electric lights for the city.

The residents of Georgetown, Del., want the streets lighted by electricity.

The citizens of New Hampton and West Union, Iowa, want electric lights.

Madison, Me., has in view the erection of a municipal electric lighting plant.

An electric light plant is to be constructed at Snake Hill, N. J., at a cost of $135,000.

The question of lighting the streets of Attleboro, Mass., by electricity is being agitated.

Frank Mayfield, city clerk of Edinburgh, Ind., writes that an electric light plant is contemplated.

Macon, Ga., is contemplating a bond issue of $500,000 to pay for electric light and water-works.

The board of trustees of Palmyra, N. Y., has granted an electric light franchise to C. C. Hunt and B. H. Davis.

A. B. Phillips, clerk of Ashtabula, Ohio, writes that the capacity of the municipal lighting plant is to be increased.

A committee has been appointed in Weymouth, Mass., to investigate and report on the subject of electric street lighting.

Bonds will be issued to the amount of $50,000 to pay for the construction of an electric light plant at North Attleboro, Mass.

The Madera Electric Light Co., Madera, Cal., capital stock $100,000, has been incorporated, to build and construct an electric light plant.

The Royal Electric Water Co. has been formed at Lake Mills, Wis. The company will make a business of putting in electric light and water plants.

The Wiston Electric Company, of South Milwaukee, Wis., has secured a franchise for erecting an electric light plant, the probable cost to be about $25,000.

The Light, Heat and Power Company of New Albany, Ind., has contracted for a new 5,000 incandescent light dynamo in order to meet the rapidly increasing demand for incandescent lights.

A bill introduced by Mr. Chesley in the Minnesota Legislature, which is general in its terms, proposes to confer upon the authorities of villages the right to issue bonds for the construction of gas and electric light plants.

Electric light plants will be built at Holland, Mich.; Stockton, Cal., Paris, Tex.; Leadville, Col.; Niagara Falls, N. Y.; Meridian, Miss.; Birmingham, Ala.; New Castle, Ind,; Hillsdale, Mich.; Brownwood, Tex.; Barberton, Ohio; Millvale, Pa.

Frank R. Dougherty, city clerk of Eau Claire, Wis., writes that the council has instructed the mayor and clerk to contract for the putting in of an electric light plant to be owned by the city. The plant is to cost $23,000. The contract with the company now furnishing light expires July 27.

City engineer Cooper has prepared estimates of what it would cost the city of Superior, Wis., to put in an electric lighting plant. He figures the cost of the plant at $60,000, and says the lights could be furnished at a cost of twenty-one cents each per light, where it now costs forty cents. This will show a saving of $15,465.05 per year, which would soon pay for the plant.

Geo. H. Fister, city clerk of Elkhart, Ind., writes that bids were received for electric lighting from the Elkhart Electric and Railway Co., the Home Electric and Power Co. of Elkhart, and C. F. Mosier, of Indianapolis. The reductions on all lights placed within one block of the next nearest light, if the contract be given for more. than two years, were: Elkhart Electric and Railway Co., 7 per cent.; Home Electric and Power Co., 10 per cent.; C. F. Mosier, 5 per cent. The Electric and Railway Co. agrees to light the city hall free of charge. All bids were referred to the gas committee.

PUBLIC PARKS.

A park is wanted at Crawfordsville, Ind.

Twenty-five thousand dollars is wanted by the board of park commissioners of Kansas City for improving Budd Park.

The committee on parks and public property at Portland, Oregon, are in search of a tract of land suitable for a city park.

The south side residents and tax-payers of Omaha, Neb., are greatly interested in the selection of a park site in the south end of the city.

The board of park commissioners of St. Paul will economize in the maintenance of parks this season and hope to be able to keep the parks in presentable condition at a cost of about $25,000.

Cheyenne, Wyo., is to have a new city park.

The park board of Seattle, Wash., contemplate improving Pioneer Place by building a pavilion, having an auditorium, store room and waiting room conveniently arranged for public speaking, etc.

Pueblo, Colo., is deeply interested in securing park sites for the city. Two donations of 160 acres each have been made to the city, on such conditions as to improvements and care as will not make them burdensome.

The committee on plans and improvements of Fairmount Park, Philadelphia, Pa., passed resolutions recommending the expenditures of $9,050 to renovate Greenland drive in Fairmount Park, and $2,500 for the purchase and planting of trees.

Topeka, Kan., is to have a new public park, and twenty acres of the fair ground will be devoted to this purpose. Twenty-five thousand dollars will be expended in laying out and improving it. An auditorium capable of seating 5,000 people will be erected.

The Quincy (Ill.) Boulevard and Park association has done much to give that city a good driving street and fine parks. It has placed a handsome park in the first ward and Madison park at Twenty-fourth and Main streets and will continue its efforts until Quincy is surrounded by a boulevard.

The park board, of Detroit, Mich., received a formal tender of a valuable piece of ground for park purposes. It is that part of the Cook farm between Jefferson avenue and the river front. The gift is in the shape of a deed, which contains stipulations that the city shall spend $1,000 annually for three years in beautifying the proposed park, and $500 a year for the next fifteen years.

Plans are under contemplation, which if carried out will make Riverside park, Sioux City, Iowa, one of the most attractive of summer resorts. It is proposed among other things, to erect a number of picturesques little two-room cottages that will add to rather than detract from the beauty of the grounds. Considerable landscape gardening and improving of roads and walks will also be done.

The board of public works of Milwaukee will ask the common council for permission to spend the following sums in sodding and planting flowers in the following parks: First ward, $50; Juneau, $200; court-house, $100; Fourth ward, $200; Grand avenue, $300; Walker, $100; Clarke, $50. For the intersections of Pryor avenue, Kinnickinnic avenue, Potter avenue and Elm street, Russell avenue and Lincoln avenue, the sum of $200 will be asked.

STREET RAILWAYS.

Frankfort, Ind., is negotiating for an electric railway.

There is talk of constructing a street railway in Van Buren, Ark.

An electric railway will be constructed at Michigan City, Ind., at a cost of $225,000.

There is talk of constructing a trolly line between Mechanicsburg and Harrisburg, Pa.

An electric street railway is projected between Eau Claire, Wis., and Chippewa Falls.

A franchise has been granted to the Rahway Electric Company for an electric railway at Rahway, N. J.

L. C. Kelsey, clerk of Elyria, Ohio, writes that the council has under consideration the construction of a street railway line.

Electric railways will be built at Napoleon, O.; Kalamazoo, Mich.; Norwalk, O.; Scranton, Pa.; Dayton, O., and Marion, Ind.

Franchises have been granted at Atlanta, Ga., to the Lithia Spring Railway Co., to construct ten miles of electric street railway.

An eastern syndicate has purchased the street railway system at Terre Haute, Ind., and will make improvements and extend the lines.

A company has been formed at Napoleon, Ohio, for the purpose of building an electric railway from Bryan to Ridgeville, Napoleon, Grand Rapids, Green Springs, Tiffin, Fostoria and Findlay.

Articles of incorporation have been filed at Trenton, N. J., and a charter granted for an electric railroad to run from Passaic to Bloomfield, Montclair, Verona and Caldwell, a distance of about ten miles. The company is capitalized at $200,000.

MUNICIPAL BONDS.

Louis Hock, Clyde, Ohio, invites bids up to May 9 for the purchase of $7,000 waterworks extension bonds and $12,000 electric light plant bonds.

Sealed bids will be received at the office of the county auditor, Cleveland, Ohio, until May 20, for the purchase of $160,000 five per cent. Cuyahoga County Brooklyn bridge bonds.

H. E. Lindsley, city clerk of Centralia, Wash., writes that that city will receive bids until 6 P. M. on Tuesday, May 9, on $22,750 funding bonds bearing 6 per cent. interest, each bid to be accompanied by a certified check for $5,000.

SOME LEADING ARTICLES IN RECENT NUMBERS OF PAVING AND MUNICIPAL ENGINEERING.

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MAINTENANCE OF ROADS IN FRANCE.
By Arthur Lagron, C. E.

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By W. P. Pierce.

MARCH, 1893.

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MORE OF A GOOD THING.

APRIL, 1893.

TRINIDAD ASPHALT DEPOSITS.
By Capt. Dolphus Torrey.

BURNED CLAY FOR ROADWAYS.
By A. W. Smith.

CEMENT SIDEWALKS, AND HOW THEY SHOULD BE MADE.
By E. L. Martin.

THE EVOLUTION OF THE BRICK MACHINE.
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TWO METHODS OF GETTING DIRECT HIGH PRESSURE FROM WATER-WORKS PUMPS.
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SEALED PROPOSALS.

WATER-WORKS.

Sealed proposals for the construction of a system of public water-works will be received by the Borough of Somerset, Pa., until 8 o'clock P. M., on Saturday, May 13, 1893. The plans cover both the gravity and pumping systems, with a reservoir, and bidders may bid on one or both of them.

The town council reserves the right of rejecting any and all bids.

For specifications and requirements address

WM. H. WELFLEY, Burgess.

STREET LIGHTING.

Proposals to light the streets of the village of Flushing, Queen's County, N. Y., will be received by the Board of Trustees of said village, at their rooms in the Town Hall, until 8 P. M., on the sixth day of June, 1893.

For information and specifications apply to G. A. Roullier, Village Engineer, No. 20 Main street, Flushing, L. I.

Each bidder will be required to deposit with his proposal or proposals a certified check in the sum of $2,000.

The right is reserved to reject any or all bids.

By order of the Board of Trustees,

CLINTON B. SMITH, Clerk.

SEWER.

Proposals to construct in Myrtle avenue and certain abuting streets in the village of Flushing, New York, about 9,500 feet of pipe sewers ranging in size from nine inches to twenty-four inches, will be received by the Board of Trustees of the Village of Flushing, at their rooms in the Town Hall until 8 P. M. on the tenth day of May, 1893.

For specifications and information apply to G. A. Roullier, Village Engineer, at No. 20 Main street, Flushing, L. I.

A certified check in the sum of two thousand dollars must accompany each bid.

The right is reserved to reject any or all bids. By order of the Board of Trustees.

CLINTON B. SMITH, Clerk.

SEALED PROPOSALS.

REPAIRING MACADAMIZED ROADWAY.

Proposals, including the furnishing of material necessary, to repair about two miles of macadamized highway, known as the Jericho Turnpike, situated partly in the First and partly in the Second Divisions of Queens County, N. Y., will be received by the Board of Supervisors of said County at the "Asylum" Mineola, until 12 o'clock noon, on the ninth day of May, 1893.

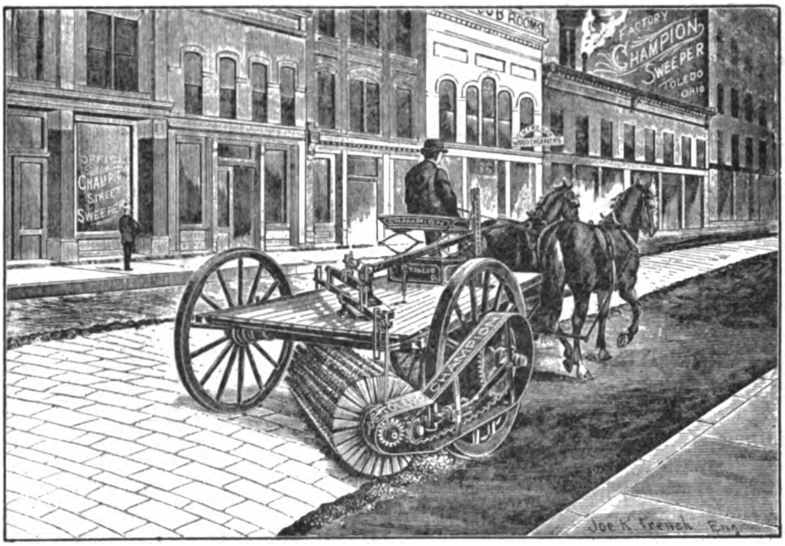
For information and specifications apply to the Division Engineers as follows: For First Division, G. A. Roullier, 20 Main street, Flushing, L. I.; for Second Division, John J. McLaughlin, Fulton street, Jamaica, L. I. A certified check in the sum of $500 shall accompany each proposal. The right is reserved to reject any or all proposals.

By order of the Board of Supervisors, Queen's county, N. Y. ROBERT SEABURY, Clerk.

PUMPING PLANT.

Sealed bids for the pumping plant for the Metropolitan sewerage pumping station at East Boston and sealed bids for the pumping plant for the Metropolitan sewerage station at Deer Island will be received by the Board of Metropolitan Sewerage Commissioners at its office, 110 Boylston street, Boston, until 12 o'clock M., May 27. The board will provide at each pumping station an engine house, boiler house, chimney and masonry foundations for the pumps. The contractor's bid for each plant must be for furnishing, setting up and completing ready for use two pumping engines (or sets of engines), four boilers, piping and all necessary appliances and fittings such as are to be found in pumping stations of the best class. Each pumping engine must be capable of easily raising 70 cubic feet of sewage per second 19 feet vertically above the level of the sewage in its respective pump well. Each of the engines must also be capable of raising to greater lifts up to 25 feet quantities of sewage inversely proportional to such lifts. Each engine shall also be capable of pumping at as low a rate as 15 cubic feet per second and at all rates between 15 and 70 cubic feet per second.

H. KINGMAN.



To the Hon. the Board of Public Works of the City of Saginaw:

GENTLEMEN—The question of purchasing street sweeping machinery for the eastern highway department, which was brought to your attention some time ago and referred to us to examine and report to you, has been under consideration by us for some time, and we now submit the following for your consideration:

We have examined the cuts and recommendations of six different machines and the testimonials of each from the city officers and municipal authorities of the cities where they are in use, and such other information as could be procured by correspondents, and we are of the opinion that the "Champion" is the best machine, everything considered, for our use.

The merits of the machine briefly are these: It will sweep from two to four inches of mud and street accumulations into windrows with one team of horses at one sweeping. It will sweep equally well on all kinds of pavements in all conditions. The use of steel wire in place of rattan or bass in the broom enables it to sweep equally clean in mud or dust and at a saving of nine tenths of the cost of keeping the brooms in repair.

Yours respectfully,
R. W. ROBERTS, City Engineer.
ALLISON J. MCINTYRE, Sup. of Streets.

At the meeting of the Board of Public Works, held March 18, 1893, the City Engineer was instructed to order "Champion" sweeping machine according to the recommendations hereto annexed.

Very respectfully, ALFRED DAVIS,
Clerk of the Board.

WHAT THE
"Champion" Sweepers Will Do.

Some Facts Worth Knowing.

They will move from 2 to 4 inches of wet mud and street accumulations into windrows, with one team of horses to each machine.

They will clean street car tracks of snow, 3 to 6 inches deep.

They will leave the streets cleaner than the most careful work done by hand, shovels and brooms, at one-tenth the cost of the latter.

They will sweep equally well on asphalt, cedar block, Medina stone, cobble-stone, macadam and brick paving.

One steel Broom will outwear from 10 to 20 of the rattan brooms now in use in other machines.

One Steel Broom, in constant use, will wear from 10 to 14 weeks.

Twenty dollars' worth of steel fibre will wear as long as two hundred dollars worth of the rattan used in other machines.

They will save their cost, broom and all, in half the first year's use.

They will give better satisfaction than any other sweeping machine that is manufactured in the world.

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ONLY FACTORY IN THE WORLD DEVOTED EXCLUSIVELY TO THE MANUFACTURE OF STREET SWEEPING MACHINERY.

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H. W. KNIGHT, Manufacturer. **TOLEDO, OHIO.**

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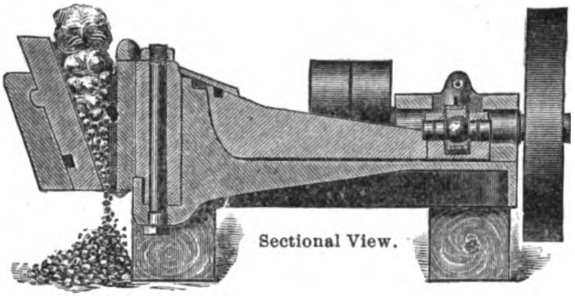

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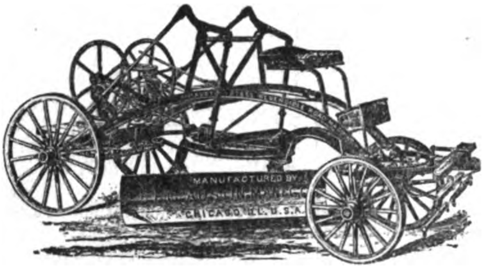

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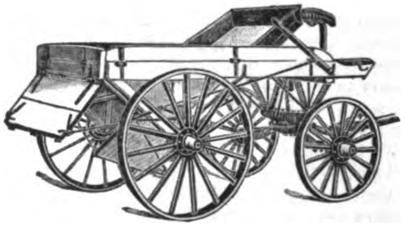

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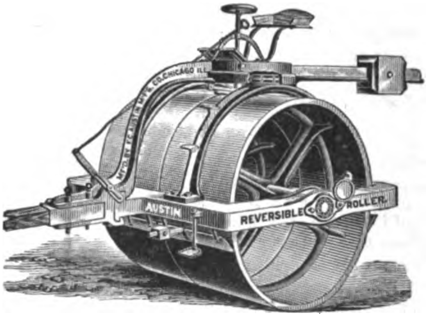

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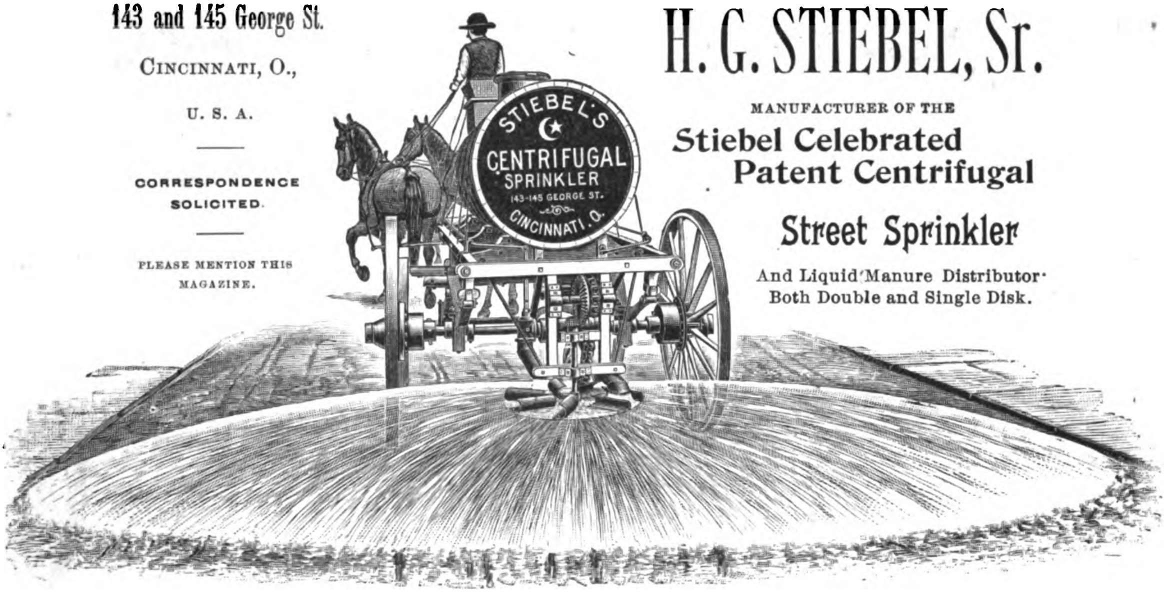

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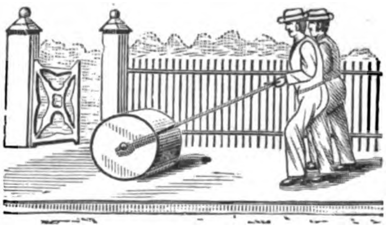

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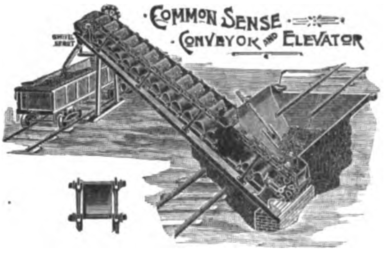

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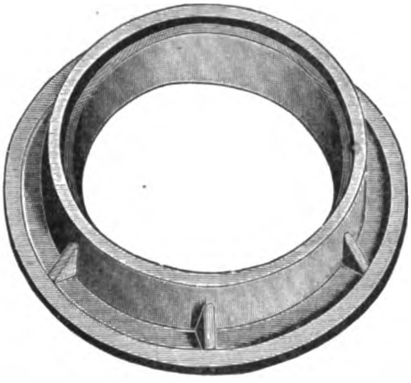

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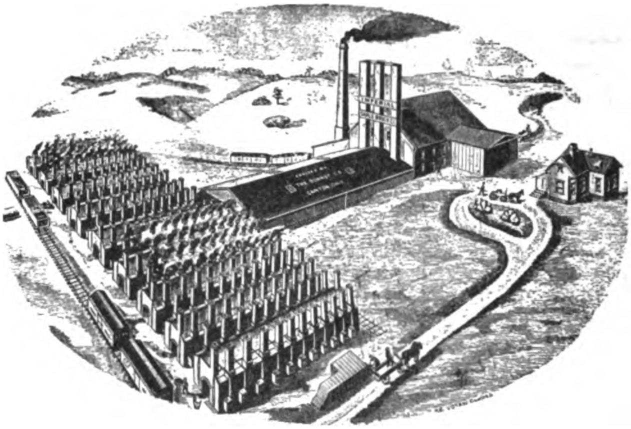

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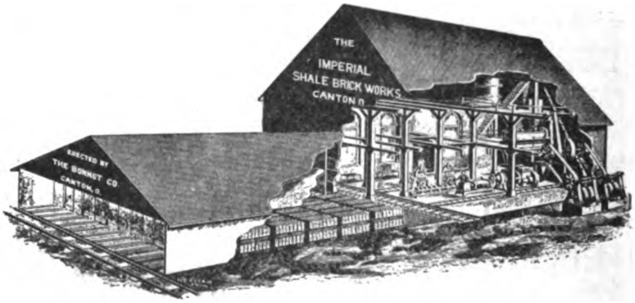
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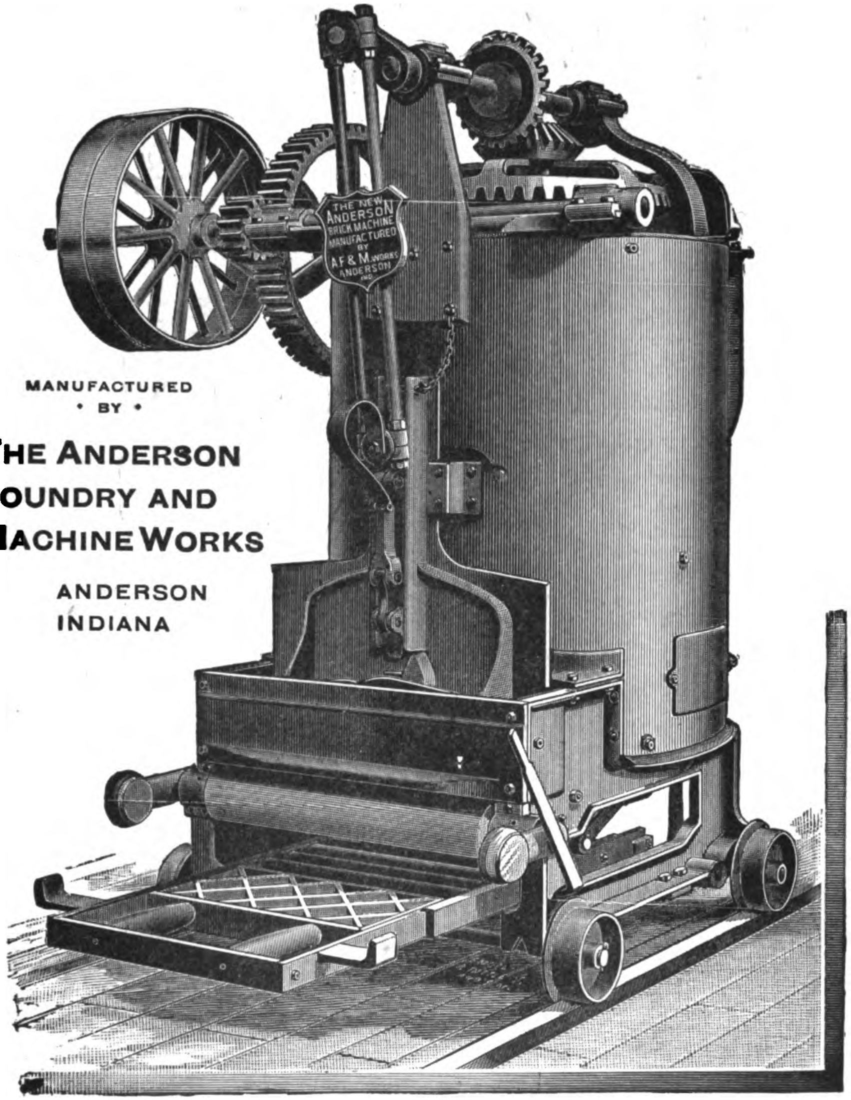

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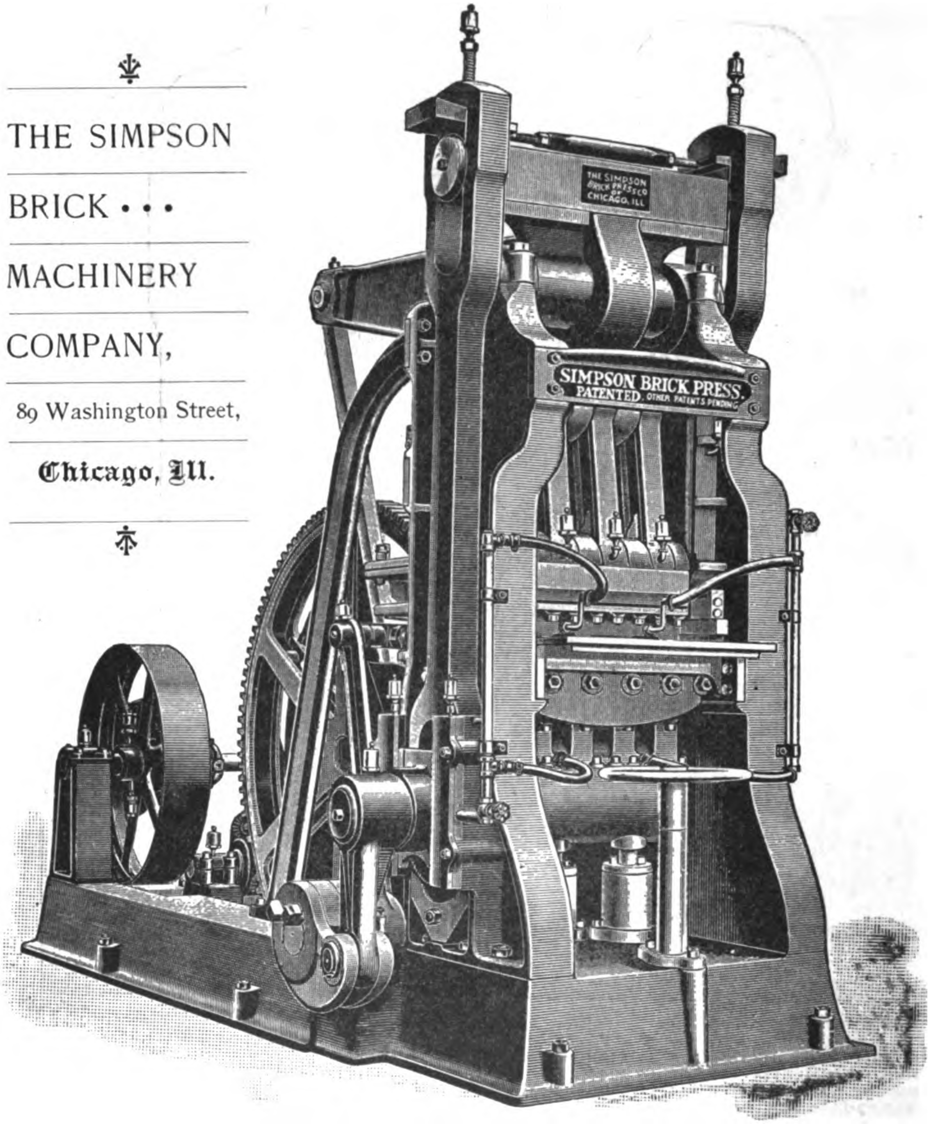
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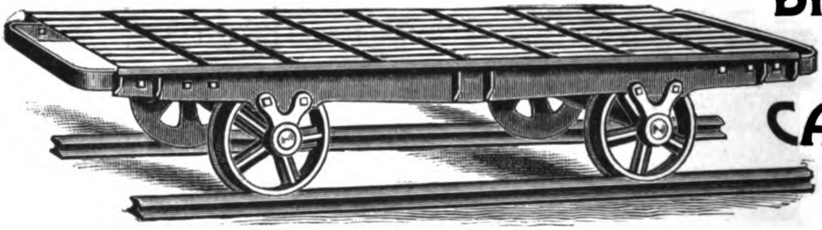

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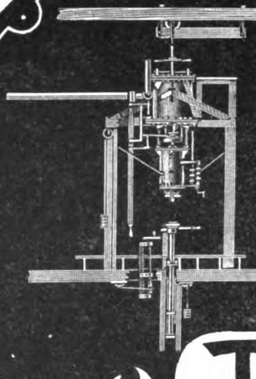

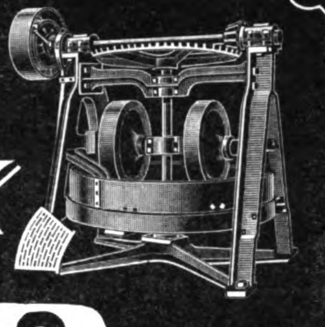

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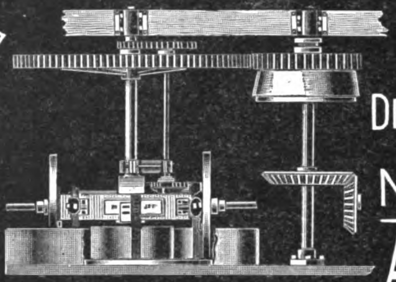

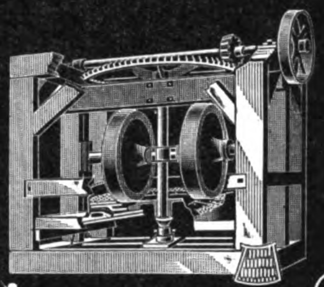

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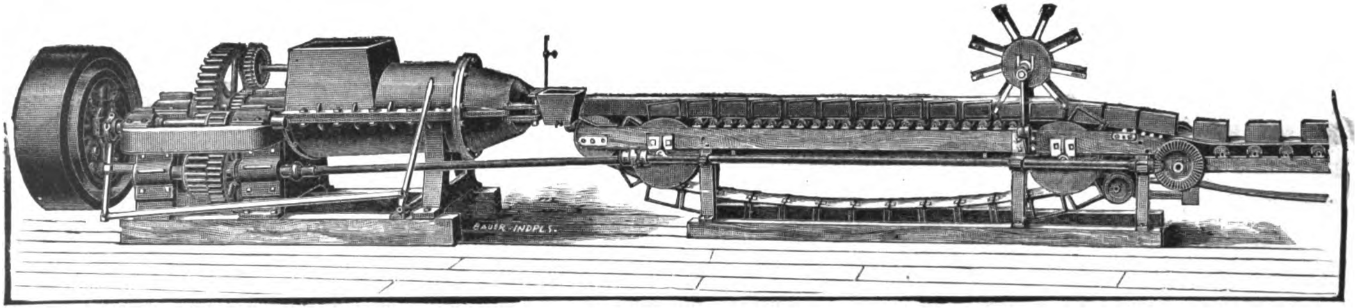

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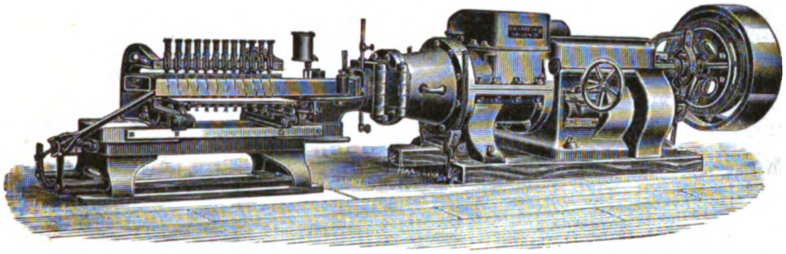

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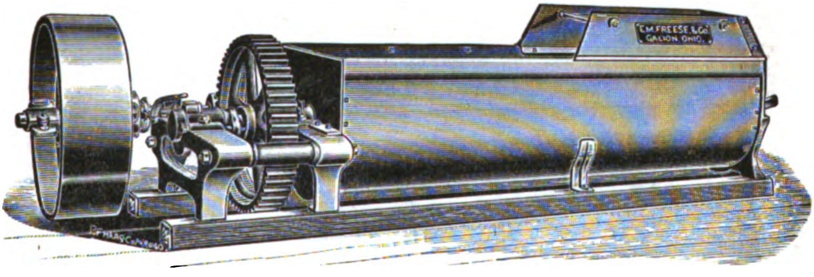
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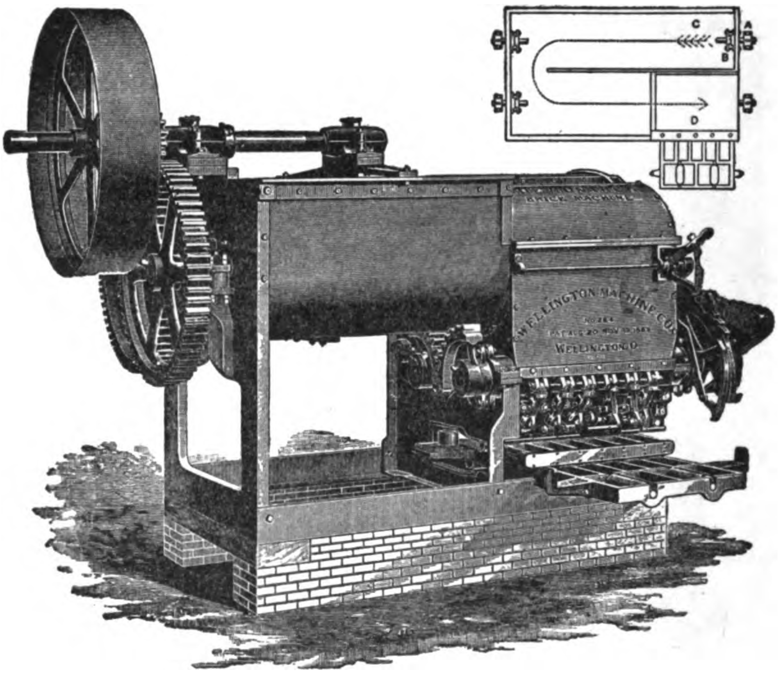

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It is the strongest, handiest, easiest running, most compact and simplest.

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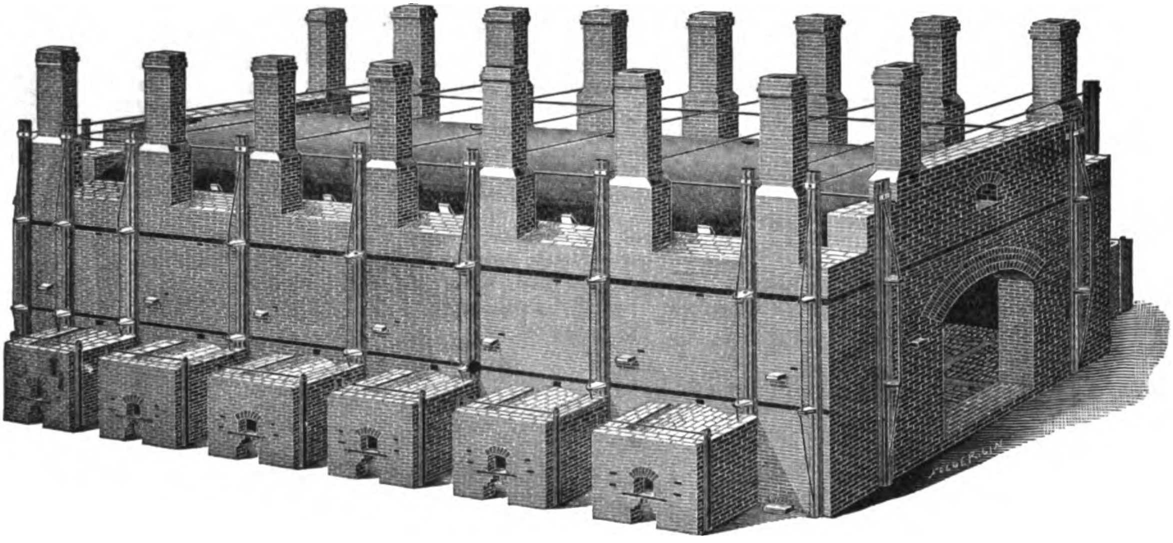

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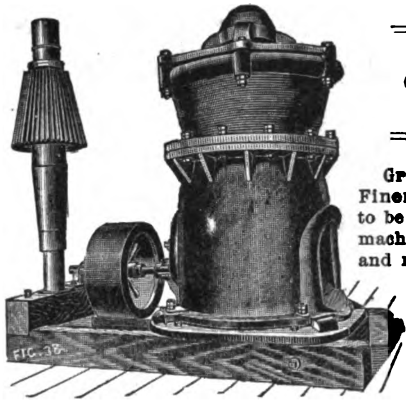

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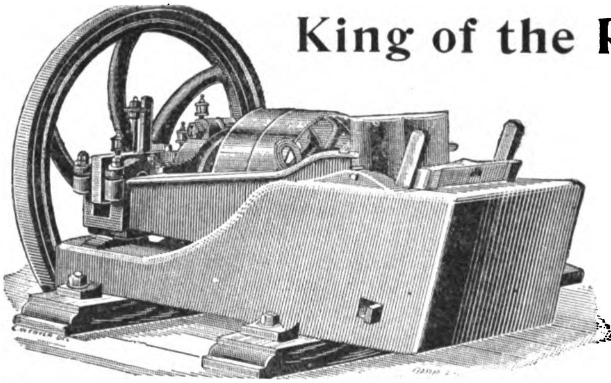

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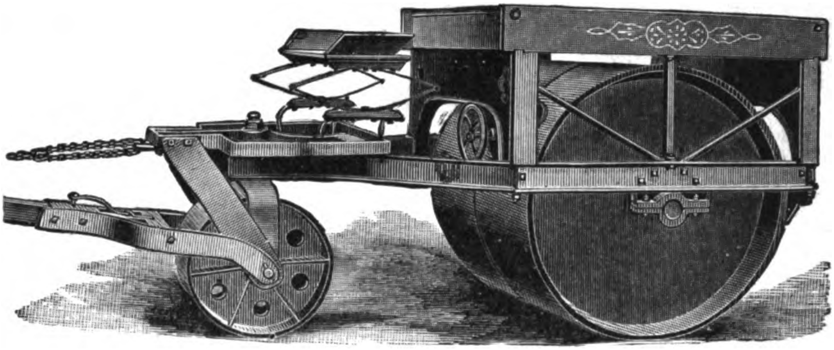

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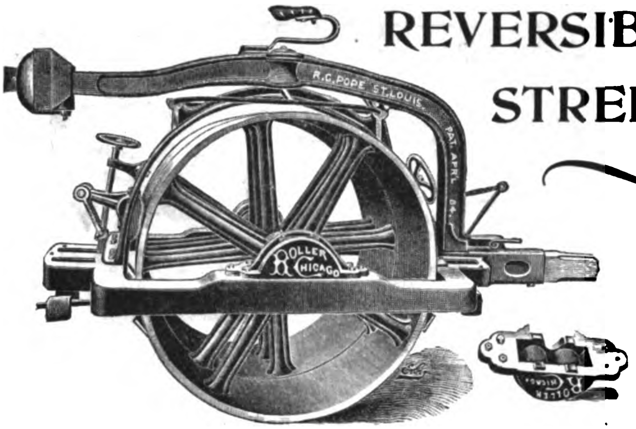

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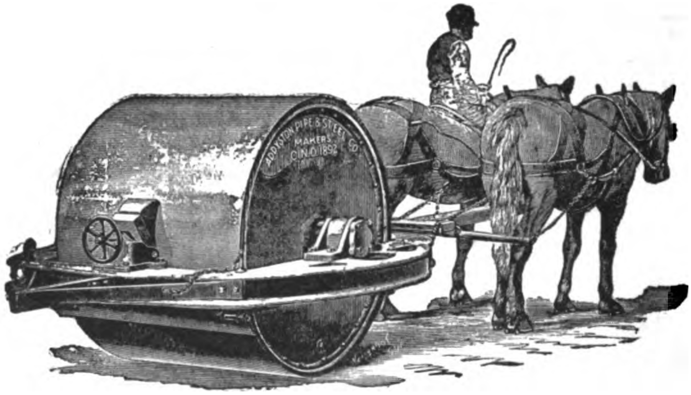

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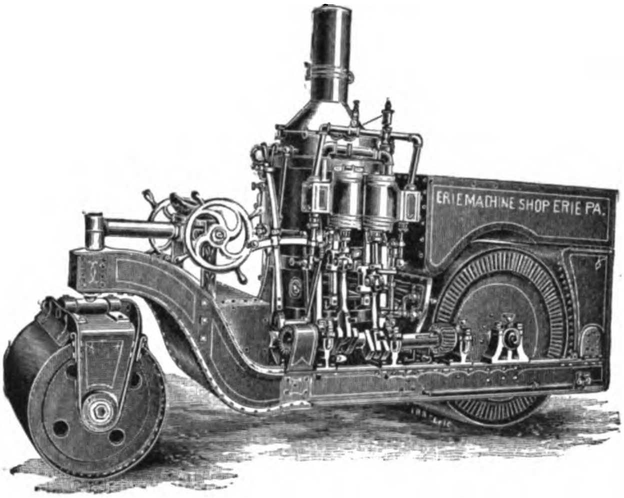
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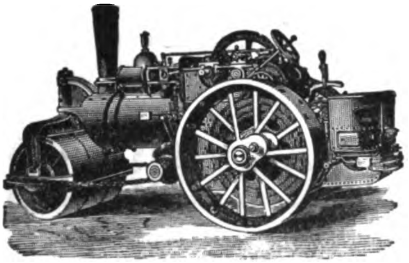

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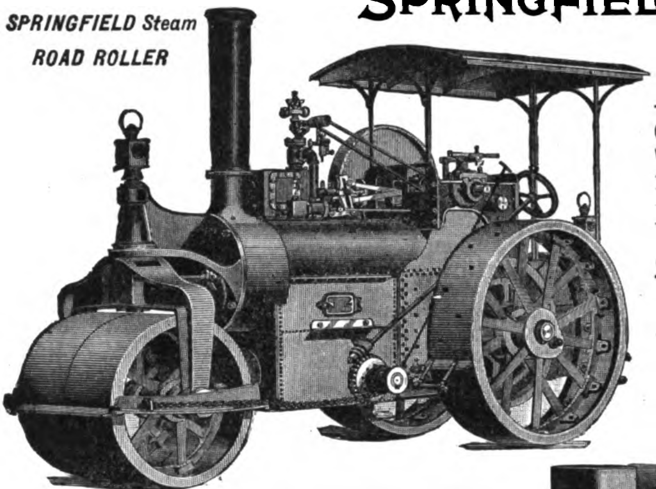

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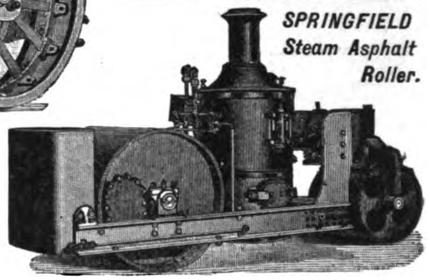

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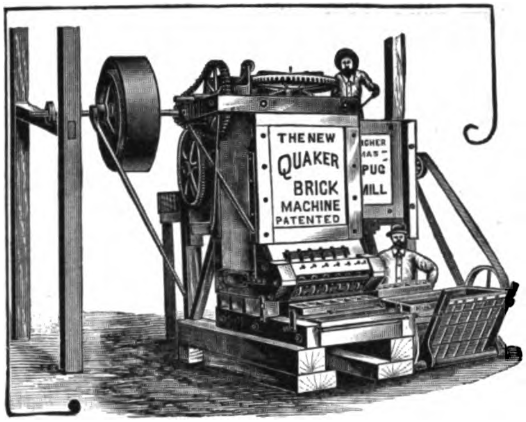

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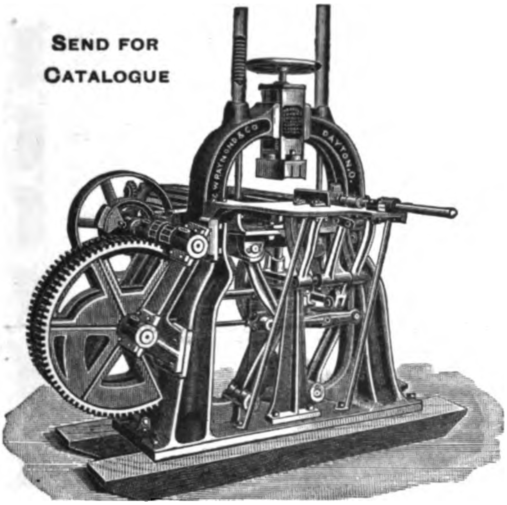

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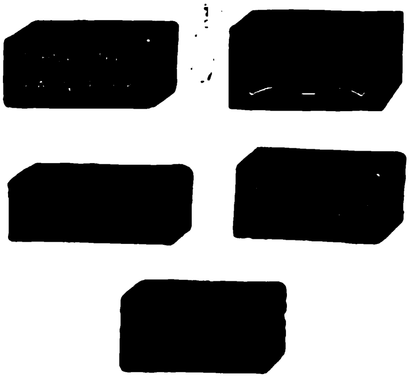

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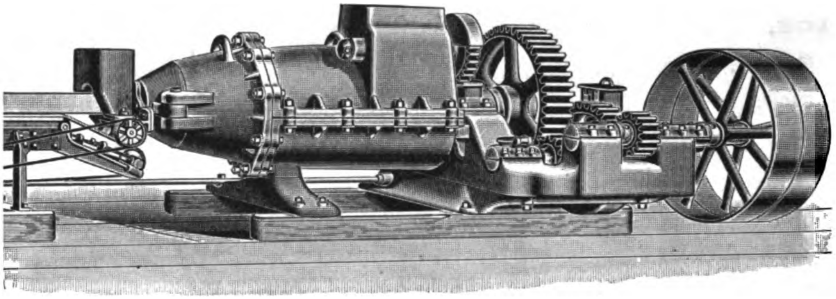

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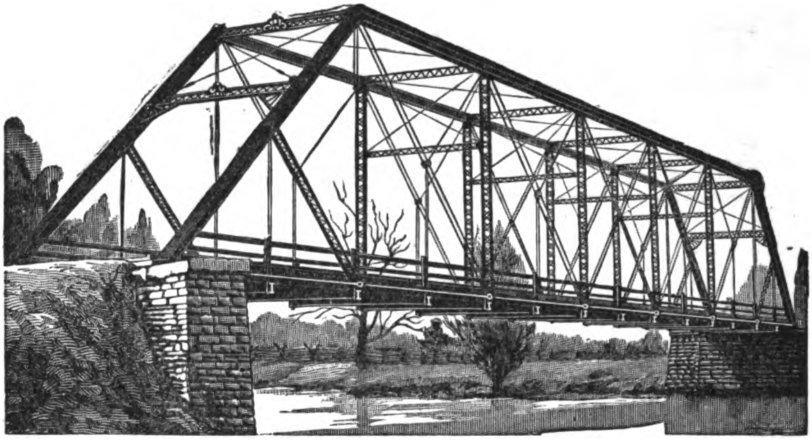

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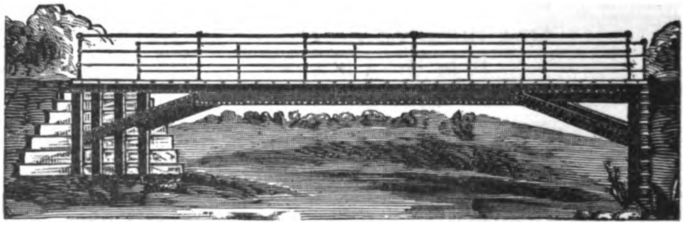

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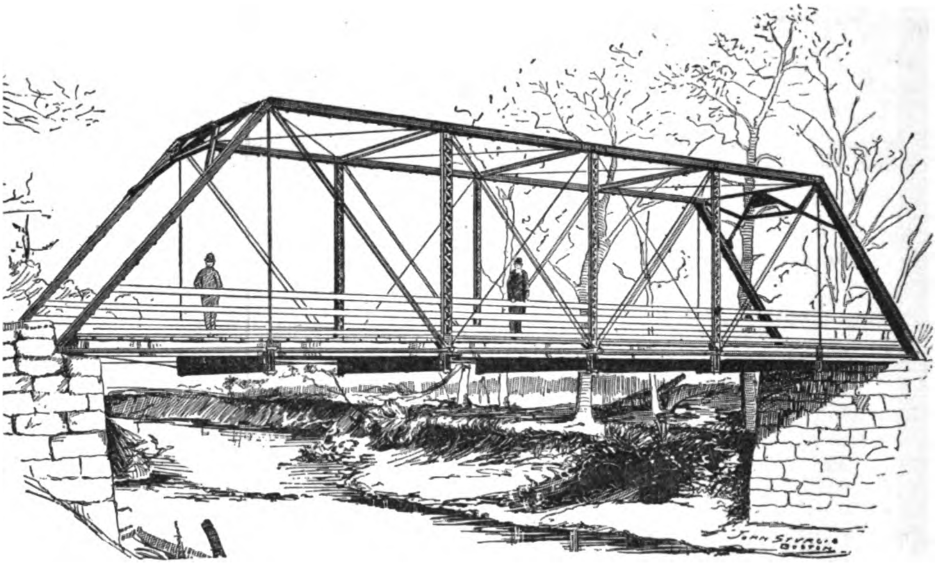

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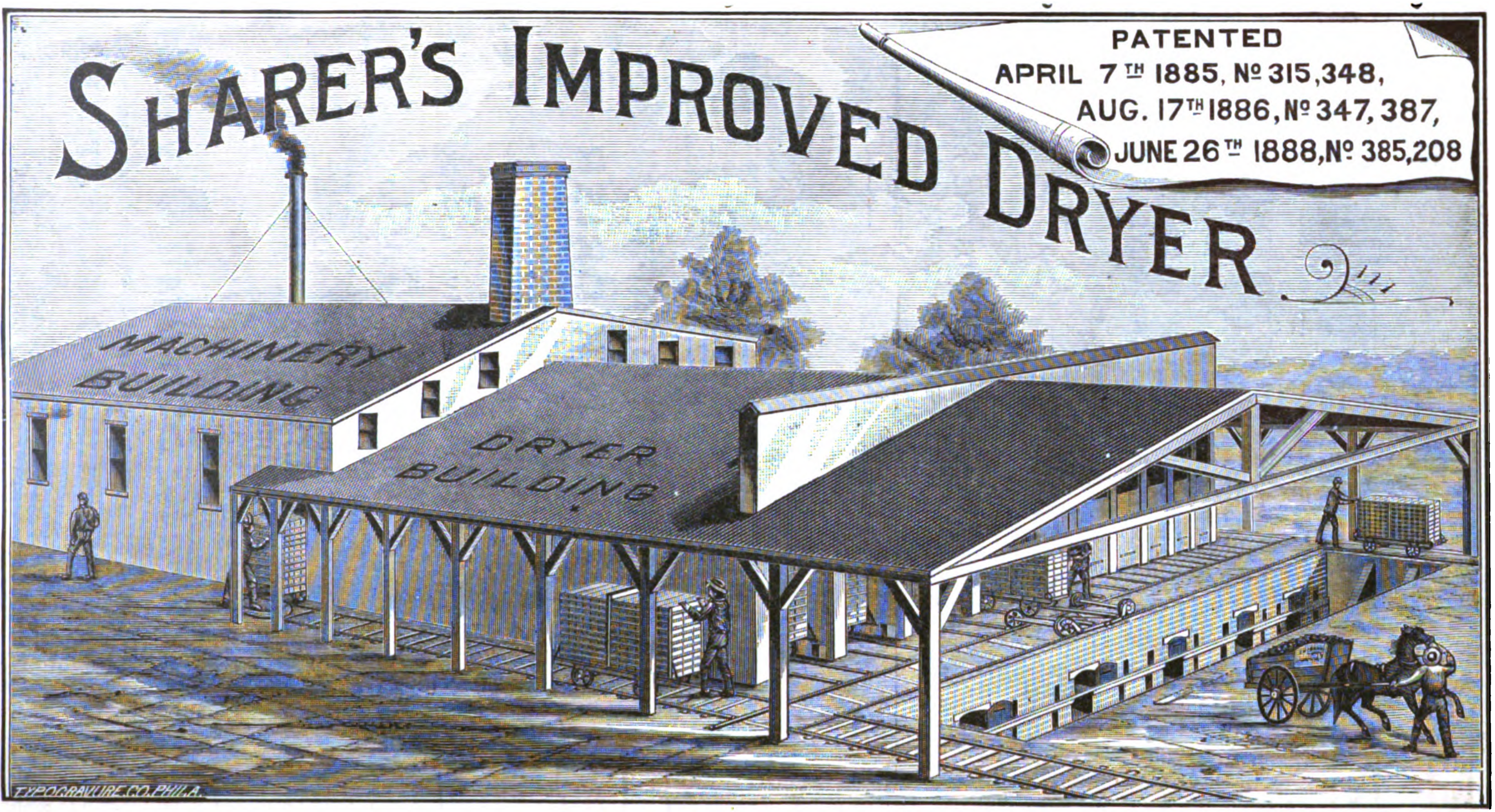

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VOLUME IV. JUNE, EIGHTEEN NINETY-THREE. NUMBER 6.

SEWAGE DISPOSAL.

I.

DURING a recent visit to Europe I visited several works for the disposal and treatment of sewage—both in England and on the continent.

I propose to give first a general outline of the different methods pursued in the removal of sewage from the centers of population and its subsequent treatment and disposal; and then give a few of the notes I have made upon the working of several of the leading processes abroad.

For removal of sewage, the water carriage system, by subterranean pipes or conduits, is becoming much the most common method where there is any organized system, as it is certainly the cleanest and most convenient. In the United States it is practically the universal method. It is quite generally used in England and is being rapidly adopted on the continent, especially in Germany. This method may be subdivided into the so-called "combined" and separate systems, as to the relative merits of which there has been so much controversy. In the former not only is the household sewage taken away by the sewers, but they are made large enough to carry off the rainfall as well, and with it much animal refuse from the streets. The amount of rainfall to provide for, in designing such sewers is still a matter of discussion among engineers, involving the questions of the maximum intensity of rainfall, the duration of rainfalls of different intensities, and the rapidity with which the rain can find its way to the sewers, the latter depending upon the slope of the surface, the condition of the streets, whether paved or unpaved, and if paved the character of the pavement. For assisting in the determination of this question, as to the amount reaching the sewers, several formulas have been constructed by different investigators—notably those of Burkli-Ziegler, $L\,Q = (1.757 \text{ to } 4.218)\ A\,r \sqrt[4]{\frac{9}{a}}$] Hawksley, Adams, McMarth and others. Very excessive rainfalls, such as only occur once in several years, are rarely followed for, as they would involve excessive expense in construction, and the sewers would for ordinary use be less efficient. With the combined system it has been more common, especially in this country, to deliver the sewage directly into a flowing stream, or into a lake, harbor or sea.

In the separate system the sewers may only receive household sewage, no rain water being admitted; in which case it becomes necessary to flush the sewers with the sewage itself by draining it back by drain flush gates at the man-holes, with water supplied by hose from a neighboring hydrant to a man-hole above the locality where the sewer is becoming obstructed—or, what is now the best practice, by automatic flush-tanks, which discharge at regular fixed intervals into the upper ends of the branch sewers a sufficient quantity of water to ordinarily keep the system clean. The rain from the roofs and back-yards of town houses may, however, also be admitted, requiring in such case less flushing water; and this is the more common method in England, where the tendency seems to be to allow more and more rain water to enter sewers of this class. Where there is no second system of storm sewers it is certainly very desirable that this limited amount of rain water should be provided for. Of the sewerage systems receiving no rain water whatever, Memphis, Tenn., is a noted example.

Enthusiastic advocates of the separate system claim that no rain water should ever be admitted and that this system is preferable everywhere. But like many other persons with a single idea they ride their hobby beyond all reason. There are many places in which the separate system would be the best to adopt and even the only practicable one—other cases in which the combined system would be far the most efficient. Each case must be studied by itself without prejudice. Where the sewage can not be turned, without treatment, into a handy river or other body of water, the separate system has an advantage in that the sewage is not so overburdened with water in a rain storm as to interfere with its proper treatment at the sewage purification works. But this result may also be accomplished by the combined system. When all the rainfall is admitted to sewers the ordinary flow of sewage may be taken by an intercepting sewer, located beneath the others and ordinarily crossing their paths near their mouths, the amount that the interceptor is allowed to receive during rain storms being regulated by the size of openings connecting the two or by positive self-acting gates controlled by floats. In order to keep the size of the interceptors within reasonable limits, and also to permit undue dilution of the sewage to be treated, they are only planned to carry ordinary dry weather sewage and light rainfall, heavy falls being discharged through the old or direct outlets, the great dilution of the sewage and the usually short periods of such discharge making this method unobjectionable. A common allowance of rain to provide for entering the interceptors is $\frac{1}{100}$ of an inch per hour; and, it may be added, the first washings of the streets, at the commencement of a shower, are usually quite as foul as domestic sewage, and it is quite as important that they should not be allowed to defile neighboring streams or bodies of water.

The greatest trouble experienced by this is during long continued rainfalls of light intensity, which keep up a flow of sewage larger than usual, and yet not greatly diluted. A prominent example of this method of interception is seen in the Boston system of sewerage, by which the sewage is removed several miles away to Moon Island, in the harbor, where it is received in a reservoir, and only allowed to float out during a portion of ebb tide, and extended series of float experiments having shown that but little of the outgoing sewage will return to the harbor again. During heavy rains the excess of rainfall, but slightly mixed with sewage, floats out of the old sewer mouth at the wharves of the city. A similar system has been proposed for the city of Washington, which suffers greatly during the hot weather of the summer, when the Potomac river is at its lowest stage, from the delivery of city sewage at different points on its water front, where it is carried up and down by the tide a number of times, becoming more and more offensive, before it is able to escape beyond the district.

With intercepting sewers it frequently becomes necessary to pump a part, or the whole, of the sewage on account of the low level at which they generally have to be driven, as in Boston, London, Berlin, Paris, and elsewhere. Sometimes the configuration of the ground permits the construction of different lines of interceptions at different levels, so that the sewage from the higher ground can be delivered at a distant point of gravity, while that from the low level districts only has to be pumped, as in London, Hamburg, and Paris.

A modification of the water-carriage system, introduced some ten or twelve years ago, which has found considerable favor abroad, and has lately been introduced in a few places in this country, is known as the Shore Hydro-Pneumatic System, and there are localities where it would seem to have much value. Its object, where sewage has to be pumped, is to avoid bringing all the sewers to the pumping station, in order to have the sewage lifted, but instead to have the pumping done at various points scattered over the city, as many as may be necessary or convenient, and at the same time have the pumps all managed from one engine-house. This is by the agency of compressed air. When the site of a town is very level, so that sufficient grade can not be given to sewers to keep them free from deposit and bring them all to a common pumping station—which, it is ordinarily demanded, should be outside—the built-up portion of its territory, without making them excessively deep as they approach their terminus. Much expense of construction can be avoided by this method; such deep sewers in a flat district, moreover, are likely to require much pumping of ground water, both during their construction and afterwards. Again, the town or city may be built in a number of little valleys, separated by ridges or swells of land, which would also make much expensive cutting and sewer construction through these ridges, in order to bring the sewage to a single pumping station.

In such cases, by the Shore system, the town is divided into as many districts as may be convenient, and a Shore ejector, working by compressed air, placed in a chamber beneath the street at the center of each district. All the sewers of a district are led, at any grade deemed necessary and quite independent of the grade of the surface, to this central point. The ejector works automatically, and either delivers the sewage into a pipe under pressure, through which it forces it to its point of delivery, or lifts it to a sewer at higher level in which it flows by gravity. Its application is to separate systems of sewerage.

It is claimed that the work done by the compressed air gives with lifts as high as twenty-five feet an efficiency of nearly 49 per cent.

Another advantage claimed for this system is such a complete separation of the sewerage districts that, in event of an epidemic of typhoid or other zymotic disease occurring in one of them, it can not be carried by the sewers to any of the healthy districts. This system has been adopted at Winona, Minn., and also at the Columbian Exposition grounds at Chicago; and, in order to provide for the crowded daily attendance expected at the latter, the ejectors of this plant will have a combined pumping capacity of 17,000,000 gallons in twenty-four hours.

Besides the water carriage system may be mentioned the Liernur system, by which the foulest portion of the household sewage is conveyed to the sewage disposal station, where the pumps are located, by a system of iron sewer pipes in which a partial vacuum is maintained during the day time. In other words, the sewage is sucked by this vacuum, first from a group of houses to a central tank beneath the street (several local sewers delivering into each tank), and second, from this tank to the station. Only excreta and chamber slops are provided for. A more detailed account of this will be given gurther on in speaking of Amsterdam. The system has not met with much favor from its expensiveness as well as for other reasons. It would seem, however, to have a limited field of usefulness in such cities as Amsterdam.

A modification of the Liernur system, called the Berlin system, has been tried on a small scale in Paris, where some three miles of iron sewer mains were connected with a pumping station. The principal points of difference between this and the Liernur system are that the partial vacuum is kept constantly on the street mains, by night as well as by day, and that the discharge from the dwellings into the sewers is entirely automatic. In the Liernur system the discharge from the local sewers to the street tanks, and thence to the station, is controlled by valves that are manipulated by a street force that during the day patrols the district covered by the sewers.

In the Berlin system the evacuator, discharging the household sewage, is generally located in the house itself. The sewerage first enters a small closed iron receiving tank, to screen out any foreign substance that might obstruct the pipes. The rotation of an axle passing through the tank and having arms of different lengths, by a crank outside, serves to detect the presence of any such substance, which can be removed by opening a door. The rotation of the arms also breaks up accumulated fæcal matter which would not otherwise pass through the wire screen in the bottom of the tank. Adjoining, and connected with this tank, is the evacuator, the outlet of which is closed by a rubber ball valve attached to a float, seated by the weight of the float and by the suction of the discharge pipe. By the action of the float the evacuator is automatically discharged whenever the sewage reaches a certain height in it. The system is said to have worked satisfactorily, although the cleansing of the receiver, especially after the lapse of days and perhaps weeks, must be a disgusting operation. It was recommended years ago by Mr. Paul Gerhard for the sewage of Coney Island, omitting the receiver, which he did not think would be needed there with the conditions prevailing.

The old pail system for removing fæcal matter from houses is still largely pursued both in England and on the continent, even in such large cities as Paris. And where cess-pools are still in use, they are emptied any time during the day, as I have seen in Florence and elsewhere, by means of a hose led from the pit to an iron cylinder, placed on a cart in front of the house, from which the air has been exhausted. Usually a small engine on wheels accompanies the tank so as to exhaust the air on the spot; the exhausted air, then, is thrown under the fire grate of the boiler, so that noxious gases are consumed in their passage through the furnace.

It seems extraordinary that, in a city of England of the importance of Manchester, there should have been, as late as 1868, no fewer than 60,000 open middens and cess-pools, covering together an area of 16 acres; and this in a population of about 350,000.

J. Foster Flagg.

J. Foster Flagg was born in the suburbs of Boston. He graduated from the Lawrence Scientific School of Harvard University at the age of nineteen. He has had a pretty wide range of experience in municipal and hydraulic work, railroad construction and mechanical engineering. After a short experience in railroad work in Ohio, and a year or two spent in astronomical work at Harvard Observatory and in Washington City, he served for nearly three years (before the war) with Gen. M. C. Meigs upon the public works of Washington. He next spent a season as an assistant engineer with the late Mr. James B. Frances, the eminent hydraulic engineer at Lowell. A short experience followed in the drafting room of one of the largest tool works in the country, and in investigating the mode of manufacture of small arms at the Springfield Armory for private parties who had a contract for their manufacture. Since that time he has spent several years in railroad and municipal work in western Pennsylvania and Ohio - has spent two years in Peru, South America, in charge of construction of large works for the manufacture of nitrate of soda, and also in railroad work. He has visited Colombia, South America, in investigations for the improvement of the Magdalena river, and has made examinations and studies for water-works in towns in the island of Cuba; has spent nearly three years in Mexico in charge of the construction of the Pacific branch of the Mexican National Railway, operating for a year the portion of the line that was completed, and has had charge in New York City of the construction of the up-town plant of the New York Steam Company, superintending also the works when completed, and made the investigations, computations, etc., in Washington, for the report upon the improvement of the sewerage of Washington, made by the Sanitary Commission appointed by President Harrison.

THE ORIGIN OF ASPHALT.

In the opinion of the writer, there is a tendency to assign the origin of petroleum, ozokerite or mineral wax, and asphalt to an animal origin, more widely entertained than ever heretofore. It is difficult to imagine any other origin for these materials as found in many large deposits, and in the case of all deposits which are productive on a commercial scale, the conditions are consistent with the theory of animal origin. Those cases of deposits within volcanic rocks, all unimportant in a commercial sense, are the only ones calling for a suspension of judgment. Still, even in these cases the presence of hydrocarbons is most likely due to the presence of fossiliferous sediments implicated in the volcanic phenomena. For full particulars about deposits of petroleum and asphalt, where the theory of animal origin is the only one tenable, the reader is referred to "Chemical and Geological Essays," by Dr. T. Sterry Hunt, first series, pages 8 and 168; and to the opinions of Prof. S. F. Peckham, in his "Report on Petroleum," tenth census, U. S.; his article in the Am. Chem., vol. iv, July, 1873, and also Proc. Am. Phil. Soc., Sept. 18, 1868.

The theory of distillation from coal and other vegetable deposits to account for petroleum is beset with difficulties, while the condition of such deposits admit of our assuming the probable existence of animal life whenever vegetable growth was possible. The mineral theories, announced to account for the generation of petroleum, appear to be without any basis of probability. They are quite fully discussed by Prof. Orton in his report on the "Geology of Ohio," for 1890, as are also the other theories of origin, and with which he gives the laws of accumulation and supply.

Messrs. Wall and Sawkins, in their report on the "Geology of Trinidad," give an account of the conditions observed by them of samples of asphalt observed or collected to illustrate its origin, and their deduction is "that one of the regular processes of the mineralization of vegetable matter consists in the production of substances of the bituminous series in distinction to those of the coal series." Their judgment was evidently based on the opinion of Bischoff (Cavendish Soc. Trans., vol. i., p. 288), and might be quite different if their observations were made at this date, and with a knowledge of the great wealth of pertinent literature which has been accumulated during the last thirty-five years since they wrote their opinion. The writer has observed, personally, in Mexico, some of the phenomena to which they refer, and explains them in a way entirely consistent with the theory of animal origin for the bitumens.

The following extracts from clippings accumulated by the writer are selected for reprint, to present some idea of the line of investigations which have established the presumption that petroleum has been derived from animal matter. It is thus an equally strong presumption that the various minerals derived from petroleum—the asphaltinea, are of animal origin. Substantially, if not exclusively, the animal remains have been those of micro-organisms, and these have possibly been of kinds whose habitat was, and is, in the ooze of sea bottoms. It may yet be determined that the species producing the deposits secreted a hydrocarbon, inherently adapted for bituminous distillation.

"The Origin of Petroleum," from the *Engineering and Mining Journal*, May 16, 1891, by R. W. R.:

"In a late number of the Austrian *Zeitschrift fur Berg-und Hut-*

tenwesen, Prof. Hoefer sums up the discussion of this subject, and claims a substantial victory for the theory of the animal origin of petroleum, which he has steadfastly maintained since 1877. The arguments in favor of this theory were at first chiefly drawn from the observed geological conditions of the occurrence of petroleum; and the principal argument against it has always been a chemical one. It has been urged that the absence of nitrogen in petroleum must be fatal to the theory of its animal origin, because an oil produced from animal substances could not fail to be nitrogenous. One answer to this argument was furnished when Dr. Engler actually produced from blubber and other animal fats an artificial petroleum, free from nitrogen, as might have been expected, since the fats are non-nitrogenous. And Engler declares that the absence of nitrogen in natural petroleum is a necessary result of its production from animal remains, because the nitrogenous flesh decays rapidly and assumes soluble forms, so that it would be removed before the fat, which is peculiarly stable, began to be transformed by the slower process of dry distillation. This proposition was confirmed by Dr. M. Albrecht, who treated several thousand mussels and fishes in this way, and found that the ammonia and nitrogenous bases incidentally produced were easily removed by reason of their extreme solubility in water.

"But Peckmam's examinations of the petroleum of California, Texas, West Virginia and Ohio showed the presence of nitrogen, and led to the general acceptance for these oils of the theory of an animal origin, which was still denied by many for the non-nitrogenous Pennsylvania oil. Prof. Hoefer, however, still held to his former view, declaring the geological conditions of the Pennsylvania and New York oil fields to be such as could not be reconciled satisfactorily with the hypothesis of vegetable origin. In his latest paper he repeats and enlarges an arument based on the presence in natural gas of more nitrogen than can be accounted for by an admixture of air. If natural gas be admitted to have resulted from the decomposition or distillation of animal remains, the probability of a similar origin for petroleum is greatly strengthened."

Omitting several references to analysis of natural gas from Asia, Europe and America, showing the presence of more nitrogen than can be accounted for otherwise than by assuming an animal origin for it, the correspondent (R. W. R.) says:

"A further proof is draw from the interesting report, published last summer by Gumbel, on the mineral and geological character of the samples taken from the sea-bottom during the scientific exploring voyage of the 'Gazelle.' In samples taken from depths of 500 metres and over, fine globules of fat were found similar in character to *adipocere* sometimes found in ancient graves, or the fat still remaining in some fossil bones. Director Gumbel recognizes the possible significance of this discovery in connection with the origin of petroleum. It is clear that, to some extent, the *adipocere* of small marine organisms is at the present time accumulating in the ooze of the deep sea-bottoms. The frequent presence of petroleum in nummulitic Eocene strata is at once suggested as a related phenomenon, and I may add that the petroleum found in the Niagara limestone, and particularly in the pores of *favosities niagarensis*, seems to be another corroborative occurrence."

"Prof. Stickenberger, of Cairo, Egypt, gives in *Chemiker Zeitung*, August 7, 1891, an interesting account of the present formation of petroleum in the Red Sea, from the bodies of animal organisms which undergo a process which may be considered petroleum fermentation. The oil is absorbed by the porous rocks of the shores and coral reefs, and places are found where it rises in them as in a sponge, and it can be seen in many places flowing out."

"The present investigations by Ochsenius and Jaloziecki have led to the definite proof that this petroleum process is still going on, that it is due entirely to animal decomposition, and that no traces of coal or fossil vegetation can be found anywhere in the shore rocks containing the petroleum."—*Engineering and Mining Journal, Dec. 19, 1891.*

Under date, November 12, 1892, *Engineering and Mining Journal* says: "R. Zalozieki (Monat. Chem. 1892, S. 498), announces the discovery of pyridin bases in petroleum from Boryslaw. This is likely to be of importance in establishing the animal origin. * * * Taking into consideration also that secondary and tertiary alcohols have been found in petroleum, as also silicon, and that the Thran oil contains no paraffin, it would appear that the chemical evidence for the animal origin of petroleum is now fairly complete."

D. Torrey.

DOLPHUS TORREY.
Biographical sketch
in April number,
1893, page 195.

BRICK STREET PAVEMENTS IN TOWNS.

I THINK vitrified brick is the coming pavement for streets. It has passed the experimental stage, having been used in Bloomington, Ill., about eighteen years; Charleston, W. Va., nineteen years, and many other places in the United States. It is said to have stood successfully long and severe tests in Holland, where it has been in use for about one hundred years, England has used them for thirty years. In many instances vitrified brick has shown as great crushing resistance as granite. "In Chicago in front of the C., B. & Q. freight depot, granite pavement was taken up on account of the difficulty of horses getting a foot-hold, and replaced with brick; they having been in for two years now, and giving entire satisfaction." Mr. B. B. Hart, of Clinton, Iowa, in answer to a request from Knoxville, Tenn., says, "That brick in use here about four years are not worn in the center one-eighth of an inch." The cheapness and excellent wearing quality, the ease with which it may be cleaned, the comfort it affords to horses, giving them sure footing, the small amount of noise and dust it makes, and the ease with which it can be taken up for repair of pavement, or pipes underneath, makes it almost an ideal pavement.

In the construction of streets, the foundation is the most important; without a good foundation no superstructure can stand. The sub-soil various in different cities, in some places we find sand or gravel, in others hard or soft clay; but no matter what the character of the sub-soil is, a good foundation must be made of it, in order to have a good street.

A defect in the sub-grade will cause one in the finished grade, a good illustration of which can be found in the April number of the *Century* of 1892. The sub-grade should be made as compact as possible by using a steam-roller of not less than fifteen-tons. No matter if the sub-soil be sand or clay, a drain of red tile should be placed on either side of the roadway, about thirty inches deep, especially if you have clay underlying your street. I think this better than one drain in the center.

The curb-stone should be of some approved quality, not less than twenty-four inches in depth, and five feet long, of uniform thickness, top dressed true and smooth.

Joints should be pointed with Portland cement and clean, sharp sand in equal proportions; stone to be set to the true line and grade of the street, on a bed of six inches of sand or fine gravel, and backed up full, with six inches of same material in the rear; both bed and backing to be thoroughly tamped to the depth of the stones. After the rolling, the substructure comes, this may be either concrete, Telford or macadam; concrete being much the best, but not used in smaller cities on account of expense, but when used, should have about eight inches of Portland cement concrete. The Telford system makes a good substructure, and in reach of nearly every city. Some may not agree with me in having the sub-grade rolled for this system, perhaps not in some cities, but in our place, if it was not rolled until after the stones were set, some of them would be out of sight. Macadam makes a very good substructure if the sub-grade is good, which is very essential. Crushed stone (screened) should be used exclusively, the coarsest for the bottom layer, which should not be over two and one-half inches in its longest dimensions, this layer should be four inches deep after being thoroughly rolled, then add a four-inch layer of finer stone, not over one and one-half inches in its longest dimensions, and well rolled, this layer to be covered with stone screenings to the depth of one inch, well watered, then rolled until the surface becomes hard and smooth, care being taken to keep the ruts well-raked in. All places not reached by the roller must be tamped thoroughly. Upon the substructure of any of the above classes good, clean, sharp sand to the depth of two inches is to be spread.

We will now place a brick pavement on any of the above substructures. In selecting paving brick, too great care can not be taken. They should be uniform in size, standard building size being best. They burn harder with more uniformity. Larger brick, when worn off, are found to be softer on the interior. They should be tough, and thoroughly vitrified, absorbing little or no water or filthy moisture on the street. All brick should be square edged and straight; free from cracks or other defects. None but whole brick should be used, except in starting a course or making a closure at curb, catch-basin, car tracks or some street intersection, where not less than a half brick may be used. Brick should be laid at right angle with curb, except at street intersections, which should be laid at an angle of forty-five degrees; joints to be broken by at least three inches. In laying, care should be taken to keep the brick as close together as possible. After the brick are laid, the end points are to be made compact by use of a lever applied to the curb. Every fifth course the brick are to be closed up, and the course straightened by the use of a sledge-hammer and bar of wood placed against the brick. The laying should not be more than two hundred feet ahead of the ramming, which should be done thoroughly, with a rammer weighing not less than fifty pounds, no iron being allowed on its lower surface to come in contact with the brick. All broken or cracked brick should be replaced with new ones, and any unevenness remedied at once.

The pavement should now be rolled with a roller weighing about five tons; all joints and spaces between the brick filled with coal tar paving cement, containing ten per cent. of Trinidad asphaltum, and the whole heated to a temperature of not less than 300 degrees Fahrenheit. When completed, the surface of the pavement should be covered with a half inch top-dressing of good, clean, sharp sand. Some claim that sand is equal to coal tar cement in keeping out moisture. I think not; besides, sand, with a small amount of soil, will support vegetation. Small cities are unable to sweep their streets every day to prevent this.

I am told that there is an ordinance in some German cities that provides for six months' notice to gas or water companies of the intention to improve a street. At the expiration of that time, the pavement is laid, and it can not then be disturbed for five years, under a heavy penalty. I think some such ordinance should be passed in our towns. Many of our new streets are torn up in places inside of three or six months after being made, by gas or water companies, either for repairs or extension of their mains. *A. W. Smith.*

A. W. SMITH.
Biographical sketch in April number, 1893, page 197.

THE GRAVEL ROADS OF PARKE COUNTY, INDIANA.

II.

In 1877 a free gravel road was built west from Rockville four and a half miles to Rocky Run. This was our first road under the free gravel road law of 1877. It was built on the road bed of the old Indianapolis and Springfield plank road, before mentioned. This plank road is altogether the best located road in our county for its length. The engineer was Mr. Conduit, then a resident of Indianapolis. He took advantage of every ravine or sloping hill-side that was near his line and running nearly parallel to his direction. I was a boy then and heard the people berating Mr. Conduit as an incompetent engineer because he ran his road up and down rough-looking hollows, when all their habits and observations had followed the ridges and highest ground generally. After I drifted into surveying and engineering, and had occasion to measure this old road-bed for the purpose of making it a free gravel road, I discovered that Mr. Conduit had exercised most excellent judgment in its location.

The Rockville and Rocky Run free gravel road just mentioned gave rise to some contention, but it was in the main between the friends of the road, and never took the form of active opposition. It was more a contention for better results than those in charge seemed to be giving. I made the survey and estimate and I feared that it would be hard to get gravel enough to build it. I provided for using coal slack from the sand creek mines as a base and cover it with four to six inches of gravel at the east end so we could swear to the law that it was a gravel road. In that case, if a bass bit our hook we called it a cat. At that time we had not learned from experience that the creek bars were inexhaustible.

Near the west end and at the top of the Rocky Run hills, the ground-hog (called in the Eastern States wood-chuck) showed us a bed of excellent glacial gravel, the pebbles all about the size of pop-corn grains. The ground-hog had dug his hole near the top of the hill, and the gravel he raked out ran down the hill-side to the bottom and made a bright streak. I then thought it was too fine and at first required it to be screened.

The contractor found screening slow work, and they sent two loads to me on the road, one the screened gravel and the other the screenings, and reported it to be a new find of gravel, and for me to pass judgment upon it. I, supposing it had been screened like the rest, accepted it as being as good as what we were using. After I was irrevocably committed to the approval of the screenings the whole crowd of haulers sprung a horse laugh on me. I could not for my life tell which was a load of screened gravel and which was the screenings unless I saw it loaded. I advised the commissioners to accept that gravel unscreened if the contractors would add one-third more to the quantity, and that was done. That gravel packed slow, but it made at last a very solid road and the smoothest I ever saw. That was a lesson learned, and the ground-hog was in part the teacher.

Our next gravel road was from Rockville, six and a quarter miles south-west to Mecca. We tried to get a petition signed the year before, but the objectors took the bulge on us, and capped it with an overwhelming remonstrance. As the law did not provide for a remonstrance, if the remonstrants afterward signed our petition, it did not neutralize their action, but placed them on our side as fully as if they were not on the remonstrance. The summer following the McCune brothers took the petition, and instead of calling meetings to discuss the matter, they went from house to house and procured the signatures of a goodly number of the remonstrants. The leader of the opposition relied on the remonstrance having as much force as the petition. The week's work of the McCune brothers showed that a vigorous effort would succeed. We did not mark out the boundary of our territory till we were ready to present the petition to the board of county commissioners. After we procured names and acres enough to build the road, and we had promised some signers not to present the petition with less than a given number of acres, we then went to still others and told them that we had enough to build the road, and would do so any way, but that if they would sign the petition it would enable us to inclose a larger territory, and thereby make the tax lighter to each. We got several hundred acres more by that stratagem. Then the citizens of Rockville subscribed over five hundred dollars to pay the first installment of tax for a good list of widows if they would sign the petition. By this means we gained several hundred more acres. Several able-bodied men also consented to be beneficiaries of that fund, and signed the petition. Be it remembered that the law required that we should have a majority of the number of freeholders in the territory, and also the owners of a majority of the acres included in our territory, but that the names and their acres of minor heirs should not be counted for or against the petition unless represented by a guardian.

We then marked out as large a boundary to our territory from which to tax the land to build our road as we could and still have a majority of the names and acres of owners. Just as we were ready to present our petition to the board of commissioners for action, one of our purchased petitioners went square back on us, and we had to buy him over again at the last minute, as we had cut so close we could not spare him.

The opposition fought us to the bitter end, but we downed them all along the line. We proceeded with great care, and put up all the legal bars as we went, and left no gaps down.

At the September term of commissioners' court of that year, a petition was presented to add three miles more to the west end of the Mecca road just described. It was along side of the creek bars and good gravel banks, and was built very cheap, and no opposition. That addition connected the east part of the county with the second bottoms on the west, where roads were seldom very bad.

The session of the legislature of 1878 passed a law providing that the county should maintain these free gravel roads. The effect of that law was to cause almost a mad rush in gravel road building in Parke county. People reasoned that if they had to be taxed to maintain gravel roads in other parts of the county, they might as well, or better, have gravel roads of their own. I made the surveys and estimates of several roads in the spring and summer of 1879, with a contingent compensation, and lost all my work, or rather the pay for it, as I got a call to fill a clerkship in a State office where I remained four years. The roads were afterward built, but as I did not finish my work I could not command my pay. When I returned to my county in 1883, I found all the principal roads graveled; but I can't say graded and graveled, for there are some outrageous hills left so steep that teams to this day pull the gravel loose and work it down the hills in pulling their loads up. The law had changed so as to allow the commissioners to appoint superintendents of construction, not engineers. Some were preachers, some farmers, some livery stable keepers, some had no regular calling at all and were appointed because they had nothing else to do. There had come a reaction on the part of the people against civil engineers, as being too expensive and fine haired. When the latter had made the survey estimate and specifications, he was dismissed and the superintendents appointed to carry out the specifications paid no attention to them, and generally did not understand them at all. If a hill was made smooth like an onion bed these superintendents lost sight of its steepness entirely; but the traveling public to-day appreciates the difference between the roads which have good gradients and those that have bad. There was no saving of expense in the cheaper superintendents, for they put in solid time and the shrewd contractors could fool them out of their eyes.

This led to bidders depending on cutting corners on their work. They would underbid others who contemplated filling the specifications and then slight their work for their profits. Bad as are some of these roads, they are incomparably better than mud roads, but they should have been made far better for what they cost. Three such superintendents, however, did good work.

One of the largest townships in Parke county has no gravel road, yet it pays a large tax to repair and maintain the gravel roads in the county. In 1883 there were two petitions circulated to build a road north and south and another east and west across that township. The people interested in them had agreed to sign each other's petitions. All was going well when one man made an idle remark about the other party's road. This remark was replied to in a similar spirit. Others joined in on both sides, and made a great many remarks not complimentary to the other party's road. What began in fun grew into an earnest debate. The debate grew into a quarrel. The quarrel grew into an expensive lawsuit, and killed both roads, and the debators are to-day a community of mud-turtles.

In building a short road from Annapolis, three miles north to Sugar creek, the engineer (not the writer) estimated that the gravel would have to be obtained from the bars on Sugar creek, and hauled up the heavy hill. The contractor bid with that expectation. After the contract was let, some one discovered that the ground-hogs had dug into the best possible gravel-beds at the top of the high hill, almost within a shovel's cast of the road. The contractor dug into the pit, killed the ground-hog, tore up his nest, flung him down the hill, and never gave him decent burial or a vote of thanks. The superintendent told me that the clear profit in building that short road was over one thousand dollars. The gravel was clean-sifted, and about the size of shelled-corn. It was deposited during the advance or retreat of the glacier. Such deposits lie covered with a thin layer of clay in many places on the highest parts of our county. In building one of our roads, we had to cross a hollow, and we put off the grading of the hill to the very last. Then we cut the hill top to make the grade, and cut into the best gravel I ever saw, and it was abundant. But we had graveled the major part of the road from distant bars and pits.

The question as to whether or not we are under any moral obligations to the ground-hog for showing us many good gravel deposits, has always had far more of interest to me than the question we discussed so long and wore out so many dictionaries looking for definitions, to determine whether a road had a beginning and an end, or whether it had two ends?

The question of a road having one or two ends had an important meaning to the people of Rockville and suburbs. So many of the roads had one of their ends in the town, and the people owning real estate would be taxed for each. After the court decided that a road had two ends, the people of the town elected a real estate appraiser, who was pledged to greatly reduce valuations, as at that time the road assessment was based on the taxable value of the real estate.

Parke county has now finished gravel roads enough in the aggregate to reach clear across the State, and enough more petitioned for and pending to reach half way back, besides several that have been killed by debating societies.

This history is yet far from complete in details, and as to individual roads, but I have given enough to show by what processes and under what hindrances we somehow acquired the reputation of having the most and the best gravel roads of any county in America.

The history of the gravel road movement in Parke county would not be complete unless I should tell what bad effect a word too little or too much in the law under which we act has caused. Our lawyers have all told us that a road petitioned for as a gravel road can not be constructed of anything else. I have found in several roads that the cheapest material of which to build them was charcoal. Still other places coal-slack. In several localities common straw. But if we are building under the law, and should use any of these, any person could successfully refuse to pay his assessment. The law should be so worded that to construct a gravel road, any material might be used that will give as good results as the available gravel.

The last road I surveyed (this year) had a long haul of gravel for the north end. There was heavy timber of the common, non-lumber kind near by, which will soon be deadened to get it out of the way. The road could have been made much cheaper by converting that timber into charcoal. A team can haul nearly as much charcoal as hay, and one load will go seven and a third times as far as gravel.

The law in Illinois is far more sensible than that of Indiana. In Illinois any material may be used to make roads that is known to be good. *Our* legislators seem to think when they meet in the state-house that they have left no brains behind them. When a law is enacted it must be followed strictly. You all remember the railroad whistling law passed by our legislature during the session of 1879. It required the whistle to blow continuously from a point eighty rods from the road till the locomotive reached the crossing. The purpose of the law was good—to give ample warning to teams at crossings—but the wording was bad. In many localities along every railroad the roads and streets and alleys which for that purpose had to be regarded as roads were so close together that the blow for one would not expire before another set in, and it took all the steam the boiler could make to blow the whistle. That law fell dead flat of its own absurd weight. Legislatures should give authority to perform needed acts, and fix reasonable limitations therefor; but they should also allow the local authorities to exercise a sound discretion for the purpose intended. The legislator from the flat, north end of our State can not draft a road law in detail that will be applicable to the Ohio river hills. Therefore, let him confine himself to providing authority to build improved roads, leaving the local authorities to be the judges of the best way to reach the result in their locality.

Another defect in the gravel road law is that it does not give enough discretion to the local authorities in locating the road. It allows engineer and viewers to straighten a road, but a road oftentimes needs to be crooked. Especially is this true in the hilly districts. I know several instances where roads were straightened, and thereby placed on worse ground and steeper gradients than they abandoned. This, too, after paying heavy damages for the new ground taken. That provision for straightening a road has generally left the impression on the viewers that it was mandatory. Viewers never seem to see that to straighten a road horizontally may increase its crooks vertically.

As our law is, and has been for free gravel roads, we can't leave a road, except to straighten it. If we wish to follow one road a piece, then cross fields or woods to another road and follow it a way, we are estopped. One of our ex-commissioners who had much experience with gravel roads while on the board tried that and was beaten in court. I know a locality that to-day would build a gravel road if the people could but do that forbidden thing. The friends of that enterprise are trying to get a road opened from one road to the other, in order to afterward petition for a gravel road over it. There must be incurred much labor and expense because a word was lacking in the law.

My experience, both in building, and getting gravel roads ordered to be built, teaches me that as our people are so wedded to old laws and old practices it will be next to impossible to get any legislature to pass any radically new law, if such new law is to go into effect all over the State at once. But if a radically new and complete bill should be matured and require that the people of any county shall first vote to adopt it before it can take effect, the members from the mud turtle counties would not object to it. But if it is to take effect at once in their counties they will very probably vote no. Therefore, give us an option road law. *J. T. Campbell.*

JOHN T. CAMPBELL.
Biographical sketch in May number, 1898, page 266.

HETERODOXICAL METHODS IN SEWER CONSTRUCTION.

The first sewer built within the present limits of South Bend was a four-foot, single ring, circular sewer, on Washington street from La Fayette street east. It was from 12 to 14 feet deep. It was constructed before the organization of the city and was intended for surface water only. Notwithstanding it is only half the thickness usually thought to be necessary for sewers of its diameter, it has stood for about 30 years and seems good for 100 years more.

The outlet of this sewer was in the West race. As above stated it was originally intended to convey only storm water, but it soon became the outlet for sewage, not only on the street, but sewers from other streets were connected with it to such an extent that the city was enjoined by the circuit court from continuing to use the race as its outlet. It therefore became necessary to cut it off and turn it north at Michigan street.

At the time this was found necessary the sewer had lasted 13 or 14 years and there was nothing to indicate a want of stability, neither was there any perceptible wear on the invert. The city engineer therefore concluded that if a single ring was sufficient for a 4-foot sewer on Washington street, that the same thickness would answer on Michigan street, and the extension north to Water street was accordingly constructed of a single ring. No indication of weakness could be detected in this extension and it retained its shape perfectly. The outlet on Water street from Michigan street to the river was constructed about the same time. It was a 5-foot double ring, circular sewer with a grade of 1 foot in 10 feet.

With this steep grade it was expected the invert would wear quite rapidly, judging from the rate at which inverts of London sewers are said to wear under ordinary grades.

Several years elapsed after this outlet was constructed before the Water street sewer was extended west. The invert of the outlet was then examined and found to be as perfect as when newly completed, having no perceptible wear.

The engineer therefore concluded that either on account of a difference in material or the uses to which sewers are subjected, or both combined, that sewers in South Bend would not wear under ordinary grades as they are said to have done in London, and that a 4-foot sewer, in our soil at least, is sufficiently stable if made of a single ring. He also reasoned that inasmuch as the greatest pressure comes on the arch of a sewer the vertical dimensions might be increased without weakening the sewer. Since that time there has been constructed nearly 6 miles of brick sewers, of a single ring, all of which under the generally accepted rules should have been double ring work. They range in depth from 10 to 23 feet. The greater portion are in good ground (sand and gravel), but some are in quicksand. More than one-half were from one to eight below the ground water line. The largest single ring sewer is 48 by 68 inches, elliptical, with greatest diameter vertical.

Its invert is 22 feet from the surface of street and on an average of 5 feet below ground water line. After eight years this sewer is in perfect condition.

No difficulty has been experienced in the construction of these sewers where ordinary care has been exercised. In one or two instances, through carelessness in drawing the curbing, or want of proper back-filling, the arch at the spring lines has been left unsupported, causing a settlement of the crown, but the same thing would have taken place if a double ring had been used, for with the lateral or horizontal thrust of the arch inadequately resisted the weight of 10 to 16 feet of earth will distort any arch of green brick work. At a conservative estimate three million additional brick would have been required to have made all these sewers double ring. Assuming the cost of these brick laid, including cement, labor and extra excavation, at $12 per thousand, the saving in cost of constructing these sewers has been about $36,000, or about $6,000 per mile. The question now is, would these sewers have been worth $36,000 more than they are now worth if they had been made of two rings instead of one? *Wm. M. Whitten.*

LOCATING ROADS IN FRANCE.

THE instructions to engineers in regard to locating public roads in France are in a great many respects similar to those given to engineers locating railroads, and may be condensed as follows:

The government orders a survey made to locate a road between two points, say two cities 100 miles distant. The engineer takes a contour map, as made by the war department, showing the topography of the country between those two points. He then makes a careful inspection of all possible routes and soon discovers one or more points between the first ones given that are to be struck.

Those are points of local importance: a river to be crossed at some favorable place, a pass between hills that is necessarily to be gone through, or a village, a mill, or some other local consideration that makes it a necessity to be reached. After having marked those intermediate points on the map, he then continues his inspection by sections. Of course if the country is level or nearly so he can simply draw a straight line and call it his location; but there may be hills and valleys to be overcome. There is where experience and good judgment come in good use.

A country road is not in that respect precisely like a railroad. There is practically no limit in the grade, or rather the maximum is a great deal higher, and I do not believe that there is any rule or formula by which one may mathematically arrive at a solution to the best location of a road, or there are so many factors to be taken in consideration, each one of them coming into the combination with an uncertain co-efficient, so as to leave the result with the engineer's good judgment.

For instance, a road perfectly level without cuts or embankments would be the cheapest and the best. There is no question about that; yet, small alternate grades, say 1 in 100, are considered entirely as good and probably preferable, as the road drains better, and animals, by using alternately different sets of muscles, do not fatigue so much. But beyond that we have to consider what it will cost to grade the road, if the investment of a certain sum per mile justifies the shortening of so many feet. Next, when we raise our grade above a certain per cent. we lessen our animal horse-power; that is to say, our horse can not draw as heavy loads, or, if drawing a buggy, can not go so fast. Therefore, it is evident that there is a line to be drawn somewhere between lengthening the road in order to get as much as we can of our animal horse-power on one side, and raising our grade to shorten the distance on the other side.

In other words, if, by going over a hill, a horse can draw one-half of a load we may just as well make the road twice as long and let him draw a full load. The same is true for a buggy. The going up and down hill without being able to trot any is so tedious that we would prefer to drive twice the distance and make better speed; yet, as I said before, there is a limit. For instance, if a horse can only draw half of a load, if the topography of the country is such that in order to obtain a more practical grade it would lengthen that road to three or four times its original length, it is evident that the short route would be preferable.

I personally have seen both extremes, roads where the engineer's hobby was that the nearer the road was to the straight line the better it was, where with a small additional cost and a small additional length they would have materially increased their efficiency (by the way, this is often the case with old Roman roads). On the other hand I myself have by the order of the government built a new road more than three times as long as the old one in order to get around a mountain. Ten years later I heard that the new road was only used by local traffic. All the through traffic preferred to either unload half of their load at the foot of the hill or double their teams, if they had two wagons, and make two trips over the mountain rather than to go around it.

But that is not all. There comes the question of maintenance. The engineer has to take into consideration that it may cost more to construct a long road than a short one, but it certainly costs more hereafter to maintain a road with a heavy grade than a level one. It will be seen that here also is a line to be drawn between saving too much capital to increase the annual expenses of repair or lessening too much the annual expenses of repair to increase the cost of construction.

It would be useless here to repeat all the small details crowded into the instructions to French engineers as to the best advantages to take of a valley or its branches or of a hill, etc., or on which side of a valley it is preferable to locate a road when both sides are otherwise equally advantageous. All these questions are well known in this country, where almost every civil engineer is more or less conversant with railroad locating; yet I wish to give one that may appear very trifling at first and still has some importance with men not thoroughly experienced in the business. It is a recommendation to make their first inspection of the grounds both ways, as the topography of a country appears somewhat different when looked at, for instance, traveling from east to west, than it will when retracing your steps from west to east.

Finally, when the location is agreed upon, then a survey should be made exactly as for railroads, plans, profiles and cross-sections. Then the details of grades, culverts, curves, retaining walls, etc., may be more carefully attended to in the office. *Arthur Lagron.*

ARTHUR LAGRON, C. E.
Biographical sketch in January number, 1898, page 17.

NATURAL AND ARTIFICIAL CEMENTS.

[From the Eighth Report of the Mineral Resources of the United States just issued by J. W. Powell, Director of the United States Geological Survey.]

LE CHATELIER has shown that the chief active agent in all kinds of cement is a tricalcium silicate, Ca_3SiO_5, which with water becomes hydrated, and solidifies to a hard crystalline mass. Calcium aluminate and ferrate are also formed, but probably take little part in the setting of the cement. The above mentioned silicate contains 26.4 per cent. of silica, and for its production a mixture containing 16.6 per cent. of silica and 83.4 per cent. of carbonate of lime would theoretically be required. As this silicate is very infusible, such a mixture could be heated to a white heat, and at this temperature all the silica and lime would combine, forming a Portland cement, showing maximum hardening properties. For cement-making purposes, however, silica is chiefly available in the form of clay, which contains also a large percentage of alumina and iron oxide; these can also combine with lime, and in general it may be said that a mixture of carbonate of lime and clay, in which the clay amounts to 20 to 22 per cent. of the whole, will, when burned at a very high temperature, yield a Portland cement.

Argillaceous limestones occur in various parts of the world, but are rarely found to contain the exact proportion of clay necessary to yield Portland cement. If the clay is present in small amount, the stone will slake after burning, yielding so-called hydraulic lime, which will harden to some extent under water. Usually the limestones containing a considerable proportion of clay show a much higher percentage than that required for Portland cement. Such stones, if burned at the high heat necessary to bring all the lime into combination, would fuse into a glassy slag, possessing no setting or hardening properties. If burned at a lower heat, however, a considerable combination takes place, the excess of clay and part of the lime remaining uncombined. The product does not slake with water, but after grinding to powder furnishes a quick-setting hydraulic cement, which, though greatly inferior to the slow-setting Portland in ultimate hardness and strength, is still very valuable for building purposes. Such cements form the chief supply of hydraulic material in this country, and are made from argillaceous limestones generally containing a large percentage of magnesia.

Practically all the Portland cement of the world is made from artificial mixtures of carbonate of lime (chalk, marl, etc.,) with clay; for it is only by means of such artificial mixtures that it is possible to secure the exact proportions necessary to withstand the high temperature required, and to produce a perfectly combined product.

Cements may then be divided into two general classes:

(1) Hydraulic cement, made from naturally occurring argillaceous limestones, burned at a moderate heat.

(2) Portland cement, made from artificial mixtures of chalk, marl, etc., with clay or ground shale, and burned at a very high heat.

HYDRAULIC CEMENT.

Natural rock cements are made in enormous quantities at various points in the United States, the product for 1891 having reached the total of 7,767,979 barrels. The most important centers of production are, in the order of their importance, the Ulster county region in New York; the Louisville region in Kentucky and Indiana; Erie county, New York; Lehigh county, Pennsylvania; Milwaukee, Wisconsin, and La Salle county, Illinois. Considerable quantities are also made in Onondaga county, New York; at Fort Scott, Kansas; near the Potomac river in Maryland and West Virginia, and in eastern Ohio, and smaller amounts in Georgia, Minnesota, New Mexico, Texas and Utah.

In most localities the rock used is a shaly limestone, usually containing a high percentage of magnesia. In New York the stone is found at the top of the Salina group, below the lower Helderberg. The outcrop of this rock extends northward along the Hudson nearly to Albany, then westward through the central part of the State to Buffalo. It is extensively worked at several points, chiefly in Ulster, Onondaga and Erie counties. The same geological formation furnishes the material used on the Ohio river and at Milwaukee, Wisconsin. The cement rock of eastern Pennsylvania and La Salle, Illinois, belongs, however, to an older formation, being the limestone of the Calciferous, below the Trenton, and lying between the Cambrian and the ordinary Silurian rocks. In eastern Ohio, cement is made from a bed of limestone of the Carboniferous period, which lies between the Pittsburgh and Meigs creek coals.

The general character of the cement rocks may be seen from the following analyses, taken in part from the Geological Survey reports of the several States:

ANALYSES OF HYDRAULIC LIMESTONES.

	Rosendale, N. Y. (Gilmore.)	Rosendale, N. Y.	Cumberland, Md. (Gilmore.)	La Salle, Ill.	Bellaire, Ohio.	Harrison county, Iowa.	Coplay, Lehigh county, Pa.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Carbonate of lime	46.00	30.72	41.80	42.25	46.52	62.21	74.12
Carbonate of magnesia	17.76	35.10	8.60	31.98	26.40	....	2.41
Silica	27.70	19.64	24.74	22.18	16.41	30.85	15.03
Alumina	2.34	7.52	16.74		5.44	5.00	3.97
Oxide of iron	1.26	2.38	6.30	....	3.38		1.93

This table shows that the cement rocks used at the principal centers of production are generally very high in magnesia. This is not regarded as a disadvantage in the manufacture of common cement, but would be fatal to the use of these rocks in making Portland, in which more than 3 or 4 per cent. of magnesia is said to render the cement liable to lose its strength and crack to pieces after hardening. The analysis of the stone used at Coplay, Pennsylvania, however, shows little magnesia, and nearly the exact proportions of silica and alumina for a correct Portland cement mixture; in fact, Portland cement is actually made in large quantity from natural rock at that locality.

The manufacture of hydraulic cement is a comparatively simple operation. The stone is burned in vertical, continuous kilns. In some cases the fuel is charged with the rock into the kiln; in others the fuel is burned in separate fireplaces and the flame allowed to pass up through the charge. The clinker is drawn from the bottom, cooled, sorted, and finely ground between horizontal or vertical millstones. Such cement, when mixed with water to a stiff paste, will generally set in less than one-half hour, and after seven days in water should show a tensile strength of 60 to 100 pounds per square inch.

The production of hydraulic cement in this country during 1891 shows a slight increase over that of 1890. The price of the product in most localities has, however, fallen decidedly, and at some points has reached so low a figure as twenty to twenty-five cents per barrel (in bulk) at the mill. It is impossible that the manufacture at this price can yield a profit. The cause of this depressed condition of the industry is perhaps in part the increased use of Portland cement, the importations of which for 1891 show an increase of more than 400,000 barrels over those of 1890. In Ulster county, New York, the production shows a slight increase, one new company at Rosendale having been added to the list of producers. In Onondaga county and Erie county, New York, the production has also increased. Moderate increase is also to be observed in Illinois, Ohio and Wisconsin, and a very decided gain in Pennsylvania, while in the Louisville region and in Kansas and Maryland the production has declined. The only new works established during the year are that at Rosendale, mentioned above, one at Cumberland, Maryland, and one at Salt Lake City, Utah, the last of which produced 5,000 barrels near the close of the year.

The following notes are appended, referring to the present state of the cement industry in various localities.

Alabama.—No cement is at present made in this State. A company at Birmingham formerly attempted to make cement from blast furnace slag and imported Portland, but these experiments have been abandoned.

Kansas.—The old works at Fort Scott, which have been owned for many years by a succession of companies, are now operated by the Kansas City and Fort Scott Cement Company. This company also has works at Kansas City, Missouri, but has not produced cement at that point for two years. New works were built at Fort Scott about two years ago by the Fort Scott Cement Manufacturing Company. These two companies now make all the cement produced in Kansas.

Maryland.—The Cumberland and Potomac Cement Company began operations at Cumberland in December, 1891.

Missouri.—The works at Silica are now standing idle.

Ohio.—Cement is manufactured at Bellaire, Belmont county, and New Lisbon, Columbiana county, in the eastern part of the State; none is now produced in the neighborhood of Sandusky.

Tennessee.—No cement is now made in the State. The works of the Howard Company, of Chattanooga, are at Cement, Georgia. At a point 2 miles north of Erin, Houston county, a considerable quantity of cement rock, claimed to be of good quality, has been quarried, but the manufacture has not yet been commenced.

Virginia.—Companies are being organized to develop large deposits of cement rock in Botetourt county, and at Savernake.

The following table gives the total amounts and values of hydraulic cement produced in the various districts during the years 1890 and 1891. (The values given include the price of barrels.)

PRODUCT OF HYDRAULIC CEMENT IN 1890 AND 1891.

	No. of works.	1890.		1891.	
		Barrels.	Value.	Barrels.	Value.
Georgia, Cement. Bartow County	1	40,000	$40,000	40.000	$40,000
Illinois, Utica and La Salle	2	363,117	292,784	409,877	276,981
Indiana and Kentucky	12	1,533,579	1,150,184	1,513,009	988,456
Kansas and Missouri	2	175,000	122,500	135,000	94,000
Maryland	4	223,209	203,785	213,900	195,955
Minnesota	1	87,650	65,737	101,875	76,406
New Mexico	1	33,750	33,750	33,750	33,750
New York:					
Onondaga County	8	292,086	190,968	300,941	197,344
Ulster County	17	2,683,579	2,218,982	2,815,010	2,252,008
Schoharie County	1	25,357	20,286	27,055	21,644
Erie County	4	765,784	560,277	788,300	575.283
Ohio	2	57,000	56,000	70,000	68,000
Pennsylvania	6	555,000	434,900	695,000	536,600
Texas	1	40,000	40,000	40,000	40,000
Utah	1	......	......	5,000	10,000
Virginia and West Virginia	2	50,000	45,000	40,000	33,000
Wisconsin	2	516,055	206,422	539,262	179,145
Total	67	7,441,116	5,676,575	7,767,979	5,613,522

PORTLAND CEMENT.

The manufacture of Portland cement is carried on in Europe, chiefly in England, Germany and France, on an enormous scale. The production in Germany during the past year is estimated to have been over 10,000,000 barrels. The demand for this valuable product in the United States is rapidly increasing, as is shown by the increased imports, about 3,000,000 barrels having been imported during 1891. The manufacture of Portland cement in this country is still in its infancy, but is undoubtedly destined to become an industry of the greatest importance. Returns from manufacturers show the total production in the United States to have have been about 450,000 barrels, but much of this is probably not, strictly speaking, true Portland cement. In view of the probable future importance of the industry, a brief sketch of the materials and processes generally employed, and of the history and growth of the manufacture in this country up to the present time, may not be without interest.

For the manufacture of Portland cement some comparatively pure form of carbonate of lime and a silicious clay, free from sand, are required. In England chalk and clay from the river Medway are generally used; in Germany calcareous marls, which are mixtures of carbonate of lime and clay, or marly limestones, form the most common material. As a source of carbonate of lime, limestone is not generally advantageous, owing chiefly to the cost of quarrying and grinding it and to the high percentage of magnesia which it often contains. Some soft and pulverulent material, like chalk or shell marl, is preferable for many reasons. Clay for cement-making must be silicious, like ordinary blue clay, not rich in alumina like kaolin or china clay, and must also be free from sand or grit. Materials suitable for Portland cement manufacture occur in great quantities in various parts of the United States.

The carbonate of lime and clay are intimately mixed, in such proportion that the cement after burning shall contain from 60 to 64 per cent. of lime. This variation is not arbitrary, but depends upon the composition of the clay employed; highly silicious clays requiring, in general, the use of a higher proportion of lime than those richer in alumina. The proper composition of the mixture must be determined with great accuracy by experiment, and closely adhered to, since a variation of one per cent. of lime in the charge will greatly affect the properties of the resulting cement. The material is mixed in a wet, semi-wet, or dry condition. The operation of mixing must be most thorough, and carelessness in this regard is one of the most common causes of failure. With certain materials it is sometimes necessary to add a small percentage of flux, such as soda-ash, in order to bring about proper combination during the burning.

The mixture is usually molded into brick and dried, then charged with the proper proportion of coke into vertical kilns, somewhat like those used for burning lime, and burned at an intense white heat for several hours. These kilns are usually intermittent, and require several days for each operation of charging, burning and cooling. In Germany the Hoffmann ring-furnace is largely used; this consists of a series of chambers connected with a central stack. The chambers are filled and emptied successively, the heat of the burned clinker in one chamber being utilized to dry the moist fresh material in another. This form of furnace is especially applicable where fuel is costly and labor cheap.

Various forms of continuous furnaces have been designed, and have been used with varying degrees of success. In these the material and fuel are charged at the top, and the burned clinker periodically withdrawn from the bottom, as is usually done in burning common hydraulic cement. The Dietzsch kiln, or Etagen-ofen, is one of the most successful furnaces operating on this plan. The great obstacle to the use of continuous kilns is the tendency of the charge, at the high temperature employed, to cake together and stick to the walls of the shaft, refusing to descend regularly, and necessitating frequent stoppages to cut out the obstructions formed.

Within a few years many efforts have been made to burn the cement mixture, in the form of dust, in an inclined rotary cylinder heated by a blast of air and gaseous fuel, the material being continuously run in at one end, and issuing as burned clinker at the other. This process was patented by Mr. Frederick Ransome, in England, in 1885, and has been subsequently modified and improved by others. Many difficulties have been met with in carrying out this plan, and the process can not be said, as yet, to have been completely successful at any of the several localities where it has been tried. It would seem, however, to be the most rational method of carrying on the burning of cement, since it effects an enormous saving in time and labor, and allows the temperature to be regulated far more exactly than is possible in the older processes. The rotary furnace has been introduced at three or four points in the United States, but its success has not yet been definitely proved. If it can be made successful, it is undoubtedly the process for this country, owing to the very great saving of labor which it accomplishes, and it remains with American engineers to overcome the difficulties which have thus far barred the progress of this promising process.

After burning, the clinker must be crushed, and ground to an extremely fine powder.

Only the finest dust has any value as a cement material, the coarser particles showing no hardening power, and acting like so much sand. Horizontal buhrstones, like those formerly used in flour mills, are found to be most effective in producing a maximum of dust. The operation of grinding is a somewhat costly one, as great power is required and the stones must be frequently dressed. The following table, taken from the records of the cement-testing laboratory of the college of civil engineering, Cornell University, shows the results of tests of the fineness of some of the best known brands of cement:

PER CENTAGE REMAINING ON SIEVES OF VARIOUS DEGREES OF FINENESS.

NUMBER.	Meshes per square inch.	Dykerhoff's (German).	K. B. & S. (English).	White's (English).	Millen's (American).	Saylor's (American).
1	2,500	0.6	10.8	7.2	4.3	0.5
2	6,400	6.2	12.5	10.8	10.1	14.1
3	32,000	28.5	14.3	14.9	19.4	26.0
4	Dust.	62.7	62.4	67.1	66.2	59.4

Although Portland cement has been manufactured in England since 1824, the date of Aspdin's patent, it is only within the past twenty years that attempts have been made to introduce the industry into this country. The first efforts in this direction were those of the late Mr. D. C. Saylor, who in 1872 began to experiment on the manufacture of Portland cement at Coplay, Pennsylvania. These experiments proved successful, and in 1875 the first American Portland was placed on the market. The process was subsequently greatly improved, and the manufacture is now carried on, on a considerable scale, by the original company, and by several other firms in the same neighborhood. The material used is the natural cement rock, which contains approximately the required proportions of lime and clay. The composition of the mixture is made uniform by suitable additions of a pure limestone. Portland cement is now manufactured at six works in Lehigh county; the product for 1891 amounted to about 250,000 barrels, or more than one-half of the total American production.

Another name closely connected with the history of Portland cement manufacture in this country is that of Mr. D. Millen, originally of Syracuse, New York. While engaged in the manufacture of sewer pipe at South Bend, Indiana, in 1874, his attention was attracted to the deposits of shell marl which are of frequent occurrence in that neighborhood, and he began experiments on the manufacture of cement. In 1877 the first kiln was built, and in the following year cement was supplied from the works to the United States Government, and used in the construction of the Rock Island arsenal. In 1886 Mr. Millen returned to Syracuse, and purchased a large bed of marl and clay at Warner's, twelve miles west of the city, the existence of which had been revealed many years before by the work of widening the Erie canal. The works at South Bend were subsequently sold to the company at present operating them. At Warner's a large plant was put up, at which during the past year 60,000 barrels of cement were made. The works have lately been purchased by a Pennsylvania company, and Millen & Sons have removed to Wayland, Steuben county, New York, where they are said to have found a deposit of white marl and clay covering more than 300 acres. They are building a large plant at this point, which will produce 300 barrels a day. Large works have lately been erected at Warner's by a Syracuse company, at a point about one mile west of the older factory. At these works the process of burning the cement in rotary furnaces, using a jet of petroleum as fuel, is in operation, and appears now to be completely successful, though many obstacles have been encountered. At the other works at Warner's the old form of vertical kilns is employed.

Several smaller Portland cement works have also been established in other States, as follows:

Ohio.—At Harper, near Bellefontaine, Logan county, an immense bed of shell marl exists, covering at least 500 acres. Works were built there in 1887, and have since been in successful operation. At this factory a large Dietzsch continuous kiln is used, the only one in this country. Portland cement is also made by a company in Columbus, from limestone and clay, with addition of blast-furnace slag.

Pennsylvania.—In addition to the extensive works in Lehigh county, already mentioned, a factory has lately been established by a Pittsburgh company at Wampum, Lawrence county. The materials used at that point are limestone, marl and clay.

California.—The works at Santa Cruz, started five years ago, are not now in operation. The material which occurs in great abundance at this point is a so-called "coralline rock," which is quite soft, and contains over 90 per cent. of carbonate of lime. It is undoubtedly an excellent cement material. Efforts are being made to re-establish the works on an enlarged scale. At Jamul, San Diego county, the manufacture of Portland cement was begun during the past year, but has not yet reached any considerable proportions.

Oregon.—The works at Portland have not been in operation for about three years, owing to litigation among the stockholders of the company. This cement was formerly made from natural rock, the burning of which was carried on in a rotary furnace.

Dakota.—Works were established at Yankton, South Dakota, in 1890, and produced over 30,000 barrels during the past year. The materials used are stated to be chalk and clay.

Colorado.—The works of the Denver Portland Cement Company have been in operation for several years, and their capacity has lately been largely increased. The material used is a finely-divided calcareous marl, brought from the foothills near Morrison, twelve miles from Denver. This marl is found in extensive deposits resulting from the disintegration of a shaly lime rock through atmospheric influences. It contains about 60 per cent. of carbonate of lime. The deficiency of lime is supplied by the addition of a suitable proportion of finely-ground, pure limestone.

New York.—Works have been established within the past year at Tompkins Cove, Rockland county, but are working thus far only on an experimental scale. A plant has been erected by one of the large Pennsylvania companies at Jordan, a few miles west of Warner's. At the works of the Buffalo Cement Company the harder portions selected from the ordinary hydraulic cement clinker furnish a Portland cement, more than 20,000 barrels of which were produced in 1891.

The following table shows the amount and value of Portland cement produced in the United States during 1890 and 1891:

PRODUCT OF PORTLAND CEMENT IN 1890 AND 1891.

STATES.	No. of works.	1890.		1891.	
		Barrels.	Value.	Barrels.	Value.
California	1	....	....	5,000	$15,000
Colorado	1	12,500	$40,000	12,500	40,000
Dakota	1	....	....	81,813	71,579
Indiana	1	15,000	86,000	15,000	86,000
New York	5	65,000	140,000	87,000	290,250
Ohio	2	22,000	49,000	35,000	82,000
Pennsylvania	6	221.000	439,050	268,500	582,850
Total	17	335,500	704,050	454,818	1,067,429

A very interesting series of experiments on the active constituents of cements, and the cause of hardening, have been published by Le Chatelier (Annales des Mines, 1887, 388, 413, 465). Full abstracts of these papers will be found in the *Journal of the Society of Chemical Industry* (1888, 567, 847). Experiments were made on the properties of different calcium silicates and aluminates. It was found that the monosilicate CaO,SiO_2, which occurs in nature as Wallastonite, possesses no hardening properties; the dicalcium silicate, $2CaO,SiO_2$, falls to powder on cooling, owing to a change in the crystalline form, and is the cause of the "dusting" often noticed in cement clinker, especially in that containing too much clay. Tricalcium silicate, $3CaO,SiO_2$, or Ca_3SiO_5, hardens to a stone-like mass in water, and is the chief active constituent in all classes of cements. This silicate is very infusible, and can not be obtained by the direct combination of silica and lime, but only by the agency of some fusible silicate, such as clay. Microscopic examination of good cement-clinker shows the presence of quantities of colorless doubly-refracting crystals resembling sections of cubes. These consist of the above-mentioned tricalcium silicate. The interstices between these crystals are filled with reddish or greenish-brown substances, which are probably silicates of lime, alumina, and iron. After hardening in water, cement shows the presence of numerous hexagonal plates, consisting of calcium hydroxide, mixed with a translucent white mass composed of interlaced groups of slender crystals of hydrated calcium silicate, $CaSiO_3,2.5H_2O$. Le Chatelier expresses the hardening of cement by the following reaction:

$$2Ca_3SiO_5+9\ H_2O=2CaSiO_3\ 2.5\ H_2O+4Ca(OH)_2,$$

according to which the tricalcium silicate is decomposed by water, forming a hard crystalline mass of hydrated monosilicate and calcium hydroxide.

The changes which take place in burning cements are thus described: At about 600° the clay is dehydrated and decomposed; at 800° to 900° the carbonate of lime gives off its carbon dioxide, and the lime remaining begins to combine with the silica and alumina of the clay. Fusible slags containing little lime are first formed; these become gradually more basic by combination with more lime, forming the mono- and dicalcium silicate, and finally the all-important trisilicate and the fusible tricalcium aluminate. The only aluminate which is stable in the presence of water, and likely to be met with in hardened cements, the author considers to be $4CaO, Al_2O_3, 12H_2O$.

TESTING CEMENTS.

Accounts of the latest conclusions in regard to methods of testing are given in *Dingler's Polytechnische Journal (281*, 114, 138, 163. Full abstract in the *J. Soc. Chem. Ind.*, 1891, 927). In order to ascertain any tendency to "blow" or expand in air, it is recommended to prepare pats of wet cement on sheets of glass, and after setting for twenty-four hours to expose them for two or three hours to a temperature of 120° C. in an air bath. Radial cracks around the edge of the pat show the cement to be unfit for use. Erdmenger has proposed a high-pressure test, which consists in exposing test-pieces of cement and sand to a steam-pressure of 10 to 20 atmospheres. It is claimed that this method shows in a few hours the strength which would be developed by several weeks immersion in water. The injurious effect of magnesia is also shown by this test. In regard to the influence of magnesia, it is claimed by Dykerhoff and others that as little as 4 per cent. causes the cement to show dangerous expansion.

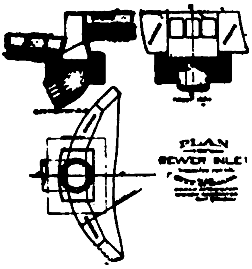
Spencer B. Newberry.

CURRENT INFORMATION.

SEWERS AND PAVEMENTS IN OMAHA.

The annual report of Mr. Andrew Rosewater, city engineer of Omaha, contains much valuable information. The expenditures for public work done under his direction during the last year amounted to over $638,000. He already has work under contract for this year amounting to $238,381. A large part of his report is devoted to sewer construction. Suggestions of general interest extracted from his remarks are given below:

"A temporary yet effective remedy on storm sewers running under a head can be produced by a reduction of the size of inlet connections by the insertion of a smaller pipe within the upper end of the existing inlet pipe, based upon such discharging capacity as will prevent any more water entering a sewer from the street during storms than will cause the sewer to run more than three-quarters or seven-eighths full, leaving the excess of temporary flow to run over the streets during periods of heavy storms."



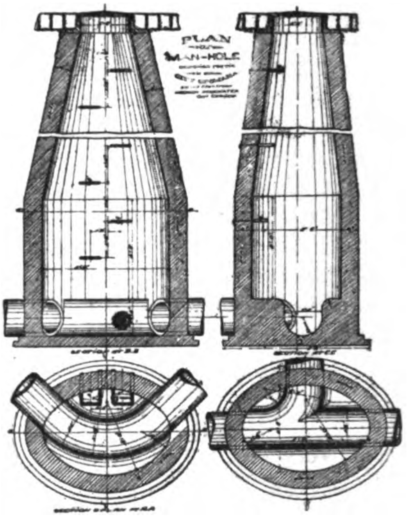
SEWER FLUSHING.

"Heretofore we have used for flushing our sewers automatic flushing tanks, which, though acting as flushers, have not rendered inspection of sewers at their upper end admissible. For the purpose of effecting this and the better ventilation of the sewers, I devised a new form for the work of the past year, which, at a slight additional expense, has attained all that could be desired. As there has been much doubt entertained as to the practical reach of flushing devices on sewers beyond a short distance, I have had a thorough test made on twenty separate lines of sewers at different points to determine the effects of 300 to 500 gallons quickly discharged at the upper ends. The results have been better than anticipated. The cleansing effect of a six-inch syphon on eight, ten and twelve-inch sewers has been sufficient to develop streams from two to three inches in depth at distances ranging from 700 to as far as 1,200 feet, in fact the average of twenty lines of sewers tested developed an average flow of two inches deep with a velocity of five feet per second on average distances of 800 feet.

"In connection with this I deem it but proper to call attention again to one remarkable feature of the sewerage of Omaha, viz: that Omaha is the only city in the world with practically eighty-five of her 100 miles of sewers on the combined plan that has no trap in a single inlet to impede the full and free flow of air through the sewers, thus precluding any possible development or collection of sewer or other gases in any of the lines of its entire system. The low mortality rate of Omaha certainly attests to the good sanitary condition of our sewers. Eight years ago I took the position that the free opening of our sewer inlets was in consonance with the undisputed theory that if any gases generated in sewers the surest way to make them inocuous and render the sewers safe to occupants of houses connected with them was to keep them untrapped and to so thoroughly dilute the gases within the sewers with fresh air as to render them absolutely harmless. I venture to say that whatever of the limited number of cases of zymotic diseases that are found to prevail in Omaha, if mapped out, will be found confined almost exclusively to localities which have no sewer facilities.

RECONSTRUCTION OF THE WARING SEWER.

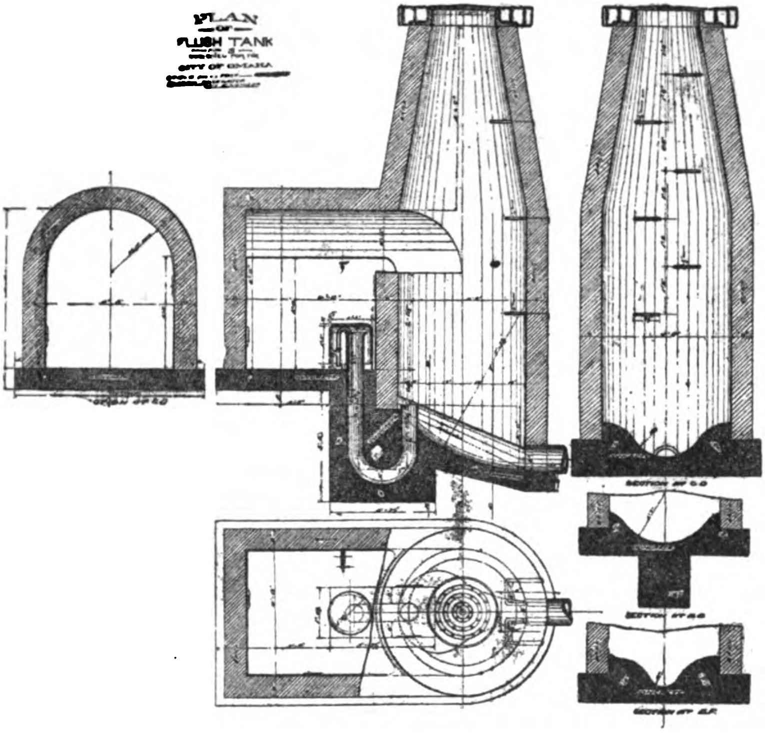
"As numerous letters of inquiry are annually addressed to the mayor and city engineer in reference to the operation of the so-called Waring sewers in Omaha, it is but due the outside public, who are continually deceived by misrepresentations on the subject, to say that but about three miles of the original fourteen of this system in Omaha remain unreconstructed, and these will require reconstruction as soon as we can arrange a new outlet main for them. The separate system of sewers, under certain conditions, when constructed upon a rational basis, has considerable merit; more parparticularly in its application to small towns. But even then, as I stated in my report of 1887, the minimum size of sewers in such a system should be based on the English separate system and not the so-called Waring plan. They should be at least eight inches in diameter. They should have no handholes to develop obstructions, but in their stead they should have man-holes at reasonable intervals for convenience of inspection, for better ventilation and ready access for periodically cleansing. House junctions, though often practicable with only four-inch pipes, will give more uniformly good results with six-inch pipes. Ninety per cent. of stoppages originate in house junction pipes, and fully sixy per cent. of these troubles can be obviated by the use of six instead of four-inch connections."



NEW SPECIFICATIONS FOR PAVING.

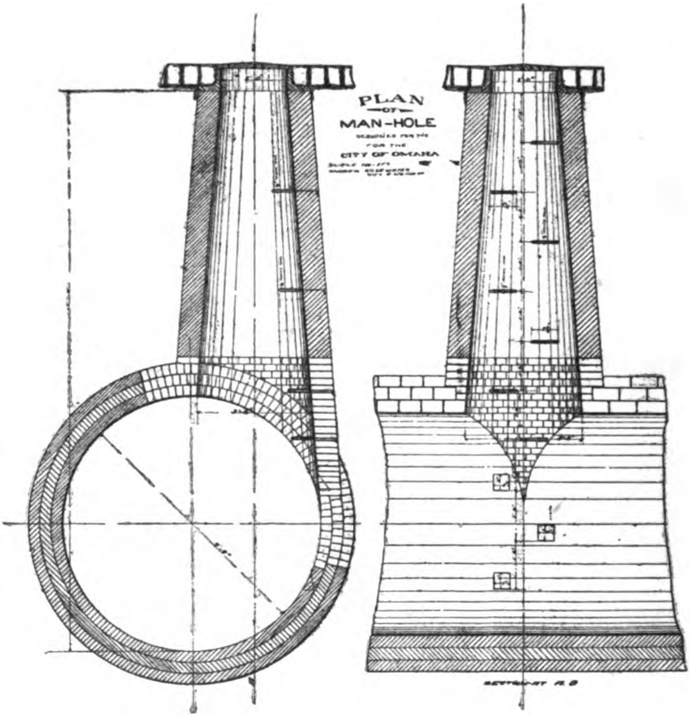
New paving specifications were prepared during the year with much care. On this subject Mr. Rosewater says:

"It was our purpose not only to embody every feature which would improve the work, but also to develop competition. This competition was to be not only of each kind of paving material with that of all others, but to develop competition of the same material to such an extent as to preclude monopoly and thereby reduce the cost. Among the important subjects first discussed was that of maintenance. The conclusion arrived at was that inasmuch as the payment of special taxes for paving extended over a ten-year period, one-tenth being payable each year, it would be wise to require the continuous good condition of pavements to be assured without additional tax for that period. It was unanimously agreed, therefore, that this should be one of the radical features in the specifications for 1892. Another important change was that in reference to asphaltum, whereby the former requirements of Trinidad asphaltum dug from the lake was stricken out and asphaltum from any source inserted, such asphaltum to be based upon a proper formula, and the requirement that it should develop a pavement equal to the best heretofore laid in Omaha, with other further provisions as to quality too extensive to detail in this report.



"After these specifications had been adopted opposition began to develop with the specious pleas that no ten-year guarantee could be obtained. That no reputable or responsible party would sign a bond of that nature, and the price would be forty per cent. higher than what had heretofore prevailed.

"The city council, under such and other misrepresentations by the contractors, sought to induce a change in these specifications, and failing by direct means, finally repealed a section of the ordinance which left the making of specifications to the engineer and the board; this in turn was vetoed by the mayor and failed of operation. Bids under these specifications were received May 13. Some of the very contractors who had insisted that no bids could be obtained on asphaltum under the rigid conditions of our specifications, nor that responsible bondsmen would sign such bids, were among the bidders with the best of bondsmen on their paper. The lowest price bid on a ten years' guarantee was $2.93½ per yard. The former price paid on five years' guarantee was $2.98.



"The council, however, rejected all bids. After considerable discussion the engineer and board agreed to modify the specifications so as to admit of bids based on five and ten years maintenance separately. When this was done an effort was made to reduce the concrete base from six inches to four inches in order to effect an apparent reduction in the price of asphaltum and bring it nearer the price of other pavements with which this material was brought in close competition. Though the board by a vote of two to one agreed to this, the engineer declined to concur and the effort proved futile. In the final revision of specifications, in view of the asphalt company's neglect to keep up the streets in good condition under their past contracts, the engineer drew up a new and more rigid section in the specification relative to maintenance, which was concurred in by the board. It was opposed strenuously by some of the asphalt companies but without avail. * * *

"Aphaltum which, for ten years under continuous monopoly control had not deviated one cent from the original price of $2.98, dropped to $2.47½ on the new and more rigid specifications, a saving to tax-payers on the contracts of the year of about $16,000, besides effecting a break in prices by developing competition which can not fail being permanent. The same rates of reduction in prices upon new pavements prevailed upon streets ordered repaved. About the same time that we were opening the field to competition at Omaha by admitting asphaltum from other localities than the so-called lake on Trinidad Island, similar efforts were made to effect like results elsewhere, notably the city of Washington, D. C."

BRICK STREET PAVEMENTS.

"The quality of paving brick is steadily improving, and for residence and suburban streets generally, brick will meet a long-felt want. Until, however, this material can be made of an unvarying, uniform good quality, its application to heavy traffic streets will be of questionable wisdom. * * * The great difficulty met with in securing proper material lies in the fact that however good the exterior appearance of a brick may seem, its vitrification may or may not extend through the entire body, and the truth can only be ascertained by breaking the brick, which spoils it for use. Aside from occasionally breaking bricks, tests have been applied by turning a stream of water upon the pavement after it has been laid and noting the soft brick by the change in color, but even this does not insure freedom from occasional batches of soft brick. The remedy seems to lie in inspection of the kiln and the selection of only such portion as observation will justify. The excessive demand for good paving brick has developed numerous brick industries with good, medium and bad products as the result.

"The paving contractor who finds he can not, under rigid inspection, get brick fast enough from any one, necessarily looks to many sources, with inevitable results of mixed products and variable qualities. So far as we have observed bricks which have a specific gravity from 2 20-100 upwards, and absorb not to exceed 2 per cent. of their weight of water are, as a rule, a first-class paving brick. The best bricks submitted to us have a specific gravity of 2.41 and absorb only about 46-100 of 1 per cent. of their weight. Until paving brick can be furnished with an assurance of uniformity in quality, stone or asphaltum must be looked to as the only material fit for the traffic of main thoroughfares and business streets."

STREET REPAIRS AND WIDE TIRES.

Mr. John P. Prichard, street commissioner of Medford, Mass., in his annual report, says:

"At no time in this country has the subject of road making been so much talked about and written about as at the present. Special consideration is being paid to the subject by our state governments and scientific schools, and large sums of money have been expended to find out the best methods for road construction.

"We have learned that it pays to make good roads, and the public will not begrudge any reasonable expenditure of money for that purpose.

"It is not promised that good roads will lower taxes in general. Increase of taxation in some shape is inevitable. To keep pace with every march towards improvement come new sources of revenue which compensate for the increase of expenses.

"It is certain we can not have good roads without paying for them, and to construct these with all their sewers, catch-basins, man-holes, drains, culverts, and bridges, furnish ample field for the street commissioner.

"To have good streets it is necessary that they be kept clean, and that the dust and mud be removed, and the ruts and depressions be filled as fast as they appear. Without continual repairs there can be no such thing as a constantly good street.

"If they are well maintained and kept in good repair they will cost less than poor streets. Good streets are expensive, but poor streets are much more so. The sum of $15,000, appropriated for general repairs of highways, would amount to only $230 per mile if it were distributed equally over the whole mileage; but of that sum the cost of taking care of catch-basins, repairs, and building of fences, repairs of culverts, drains, crossings, care of snow, etc., etc., reduces the amount to a still smaller amount. The system adopted two years ago, of having road material deposited in heaps along the main streets, convenient for the road men who take care of certain streets by removing all obstructions such as tin cans, pieces of boards with nails in them, hoops, paper, wire, etc., keeping the gutters clean and catch-basins open, filling up the ruts and bad places as they appear, has proved satisfactory. To facilitate the work each man has a small hand-cart provided with a shovel, rake, pick, and broom.

"The greater the width of a tire, the longer the life of the roadway. The growing practice of using narrow wheels for vehicles carrying heavy loads is very destructive to the roads, the width of the surface covered by the narrow wheel not being sufficient to bear the heavy weight imposed on it. It has been proved by repeated and careful experiments that wheels with two and a half inch tires cause double the wear on a road that wheels which have four and a half inch tires do. On good roads there is no great advantage in a greater width than four and a half inches.

"Telford's rule was one inch of tire for every five hundred weight on the wheel. By this a cart weighing with its load two tons would require four-inch tires.

"Wheels of a large diameter do less harm to a road than small ones. In making repairs to our carts we put on five-inch tires on the hind wheels of the four-wheeled carts, and four-inch on the fore wheels, the front axle is shortened eight inches, so that we roll a space of eighteen inches when the cart moves, and it is surprising to see how easily they will go over switches, frogs, and grooved railroad tracks. The two-wheeled carts we put on four-inch tires, and I wish that everybody that owns teams could be induced to adopt wide tires."

CLEANING OF STREET RAILWAYS.

The advantage of keeping street railways clean was the subject of a paper recently read before the English Society of Engineers, by Mr. H. Conradi. He said that the tractional resistance between clean and dirty rails varied as much as thirty pounds. Cleaning by hand, once a day, says Mr. Conradi, costs twenty-five cents per mile of single line, in fine season, and twice as much in bad weather. Watering by cart twice a day costs sixty cents per mile. Cleaning by a special device successfully used on the tram cars of Reading, England, for the last eighteen months costs twelve cents per day, and even less.

NOTES FROM A CITY ENGINEER'S REPORT.

Mr. Harvey Linton, city civil engineer of Altoona, Pa., has crowded a vast amount of useful information into a few pages in his last annual report, which has just been published. A report of some of the tests of material made under his direction is given herewith.

CEMENT TESTS. "NEAT."
BY CITY ENGINEER LINTON, ALTOONA, PA.

Cumberland.	1 Day.	7 D'ys	30 D'ys	60 D'ys	90 Dy's	120 D'ys	150 Dy's
No. made	85.	59.	14.	9.	19.	6.	2.
Maximum	196.	260.	290.	320.	340.	336.	306.
Minimum	84.	102.	198.	200.	202.	274.	276.
Mean of all	129.5	176.4	254.6	265.5	246.5	304.	291.
***Louisville.**							
No. made	15.	16.	11.	4.		2.	1.
Maximum	163.	178.	204.	184.		232.	270.
Minimum	76.	83.	158.	114.		228.	270.
Mean of all	115.2	112.3	178.3	138.5		230.	270.
Acme.			15 D.				
No. made	6.	4.	2.				
Maximum	70.	88.	196.				
Minimum	54.	24.	152.				
Mean of all	65.	46.	174.				
Imp. Rosendale							
No. tests		6.					
Maximum		110.					
Minimum		84.					
Mean of all		96.7					

ONE-HALF SAND AND ONE-HALF CEMENT.

Cumberland.	Mapleton sand.					Ore Hill.	
No. tests		1.	3.		22.	7.	
Maximum		82.	90.		198.	184.	
Minimum		82.	79.		94.	107.	
Mean of all		82.	85.		150.7	132.4	

**Louisville.*	Mapleton sand.				Ore Hill sand.		
No. tests		1.	3.	2.			
Maximum		92.	108.	72.			
Minimum		92.	70.	70.			
Mean of all		92.	94.	71.			

*Black Diamond brand.

Some extracts from his report are given below:

"In freezing weather a mixture of one pound of salt and eighteen gallons of water was used in making cement mortar and concrete, to which was added about one ounce of salt for every degree of temperature less than 30 degrees Fahrenheit."

"Enterprising quarrymen may be able to meet the requirements for uniformity of depth of blocks and thus greatly improve the character of Belgian block paving.

"Perhaps, if the stone blocks were set with their *smooth* top surfaces exactly on the line of the grade of the finished street surface, in a concrete bed one inch in thickness, of fine gravel and cement—mortar while it is in a plastic state—the result would be satisfactory, supposing, of course, that the foundation is of concrete, at least five inches in thickness."

"The width of stone blocks should not be more than 3 to 3½ inches on grades of 4 per cent. and upward."

"Steel-pointed shoes of horses work the greatest injury to brick pavements."

"In specifications for brick paving, uniformity as to hardness should be insisted upon, and the contractor required to remove all soft and defective bricks that show in the pavement within two years after its completion, and make all necessary repairs, furnishing new bricks uniform in quality with the paving."

STREET PAVING IN SEATTLE.

Reginald H. Thomas, city engineer of Seattle, Wash., in his annual report, just published, says that it has been the custom in Seattle to supplement the first grading improvement, when necessary, with fir planking, laid at the general expense. "In this manner," he adds, "all of our principal business streets and a few of the main thoroughfares to the outlying districts have been rendered available for the trade and travel of the city. Other resident streets, not thus favored with facilities, are for several months in the rainy season frequently almost impassable. It would seem that the question of paved streets for our business districts and 'hard roads' for outlying routes of travel must be met at an early date. The expense of maintenance and repairs of our planked streets is of itself a large item, aside from the injurious effects upon the public health, resulting from the decay of vegetable matter and its diffusion into the atmosphere. The development of the process of producing a quality of brick unexexcelled for paving purposes has been well indicated by the tests of brick submitted for lining our sewer tunnels. With the establishment of large plants tributary to the city, involving the use of home resources and labor, capable of producing a form of brick suitable for substantial street paving in any desired quantity, it would seem that the problem of street paving in Seattle might be brought to a speedy solution. The good roads which have usually resulted from the use of 'macadam' commends it to me as the most suitable, available and permanent method for improving our outlying streets, especially such as are well-traveled avenues of communication to the suburbs of the city."

PLANS FOR A GREAT BRIDGE.

English and French engineers have for a quarter of a century been looking forward to the tunneling or bridging of the English channel. The tunnel scheme has been indefinitely abandoned, but there is still a hope that the bridge will be built by the end of the century. Recent progress in engineering and metallurgy makes the construction of the immense structure possible if not altogether probable.

The plans of Engineer Hersent, of France, are for a bridge thirty kilometers in length with a platform one hundred and fifty feet above the sea at high tide, high enough to allow large steamers and tall-masted sailing vessels to pass under it, and wide enough to support four railway tracks, besides a road for carriages, foot passengers, etc. Places of refuge, watchhouses, alarm bells and electric lights will be placed at each pier. It is believed that a foundation for piers may be constructed without much trouble by the aid of compressed air diving bells, as the channel's depth between Calais and Dover does not exceed fifty meters at any place, the average being from twenty-five to thirty-five meters. The plans call for 4,000,000 tons concrete, 2,000,000 tons wood and lead, 3,000,000 tons iron and other metals which will make the bridge proper weigh about 9,000,000 tons. The cost of the entire structure will be in the neighborhood of $200,000,000. The plans are soon to be submitted to an international technical committee. If the committee report favorably and the desired concessions are granted, the work will be commenced immediately. It is said the structure could be completed in six years.

CONSTRUCTION OF A ROMAN ROAD.

A Roman road, near Moffat, in Scotland, has been closely examined by Mr. G. T. Johnstone. The road was 21 feet wide, with a whinstone curb on each side. Exclusive of the turf covering it was 23 inches deep from foundation to crown. The foundation was a layer of clay, 6 inches deep in the center, and tapering to the sides, with undressed stone bedded from 1 to 1½ inches into the surface of the clay. Then came a layer of stones, 11 inches deep, about equal in size to a boy's head, and with the vacancies filled with "till." A 4-inch layer of smaller stones formed the top surface of the road. At another place the clay and stones were mixed together like concrete in a bottom layer, 11 inches thick, with the 4-inch smaller stone layer above.

BOSTON'S PROPOSED SYSTEM OF (RAPID TRANSIT.)

The legislative committee has decided on a definite proposal for Boston's rapid transit. It is the idea of C. C. Coffin. The city is to provide a clear right of way through alleys and narrow streets and receive proposals for the construction, which is elevated. Then the system would be let for twenty-five to fifty years to the highest bidder, at the end of which time the ownership and control would revert to the city. The cost of double track structure is estimated at $1,000,000 a mile.

A NEW PAVING BRICK COMPANY.

N. T. Barnes, of Buffalo, is organizing a company in Superior, Wis., for the manufacture of a new paving and building brick. The capital stock has been fixed at $100,000, nearly all of which has been subscribed.

The brick is of a peculiar kind, an invention of Mr. Barnes. It is made of a mixture of clay, shale and sand, and when mixed in the right proportions the result is a material as hard as steel or glass. Mr. Barnes' way of proving the hardness of his brick is to strike it with a piece of steel, which, instead of breaking the brick, causes the sparks to fly. When used for paving the brick are interlocked so that the pressure falling on any one is distributed through several.

LOUISVILLE'S STREET PAVEMENTS.

City Engineer Charles V. Mehler, of Louisville, reports that the paved streets there now comprise 19.22 miles of granite, 5.80 of asphalt, and 2.18 of brick. He says that owing to the decreased price of labor and material, there has been no time in the city's history when public work has been done cheaper.

SOME RECENT INVENTIONS.

An Insulated Pipe Joint or Coupling. 495,513. Thomas J. Pierce, Philadelphia, Pa. This invention consists of two separate parts, each having a depression, which depressions firmly hold or secure an insulating block surrounded by additional insulating material and a collar uniting the parts together and insulated from the upper part.

A Bridge. 495,621. Joseph W. Balet, New York, N. Y. This invention comprises a suspension bridge with a cantalever girder to stiffen the roadbed, towers resting upon the cantalevers, a suspension cable supported by the towers and anchored to the girder and vertical suspenders between the suspension cable and the girder.

A Hydrant. 495,711. Adam Schied, Harrison, N. J.

A Process of Treating Sewage. 495,834. James J. Powers, Brooklyn, N. Y. This invention consists in causing the sewage to move forward through suitable conduits, introducing disenfectants at the head of the conduit, also substances forming with the sewage, compounds insoluble in water, removing the floating and sedimentary matter, simultaneously treating the entire body of sewage with a disinfectant or germ destroying gas, and finally treating the water separated out by means of liquid disenfectants.

A Draw Bridge. 496,074. George H. Thomas, Sing Sing, N. Y. This invention comprises an end-lift bridge, a tower, a lifting flexible member, a sheave, a drum actuated by a motive power, a sheave, a subdivided counterweight, and catches arranged for supporting the subdivisions of the counterweight when detached.

A Pavement. 496,099. Eugene Robinson, Detroit, Mich. This invention comprises a combined brick and aspaltum pavement constructed by arranging the bricks therefor upon a suitable resisting foundation, and combining wherewith a coating of hot liquid asphaltum in such manner that the coating becomes incorporated in the brick and the interstices and forms a resisting surface, incorporating therewith, before cooling, inert material to increase the durability.

Sidewalk or Building Block. 496,201. Frank C. Klinder, Sheboygan, Wis. This invention consists of a center of hard burned brick, and a veneer of artificial stone.

A Garbage Receptacle. 496,243. Albert H. Zenner, Detroit, Mich. This invention comprises a fence or wall having an aperture therein, a triangular garbage receptacle detachably pivoted at its apex in the lower edge of the aperture, and adapted to be rocked to either side of the fence.

A Brick or Tile Cutting Machine. 496,286. Assigned to the Frey-Sheckler Company, Bucyrus, Ohio. This invention comprises a carrying apron, cutting wires of a cutting table, a roller under the apron adjacent to the cutting wires formed with tapering ends having anular end flanges whereby the outer edges of the apron are supported.

An Apparatus for Testing Pipes and Tubes. 496,438. Arthur O'Brien, Helena, Mont. This invention comprises a casing, a collar below the casing, an electric gasket, a binding collar, a plunger operating with the collars, to expand the gasket, a lever for operating the plunger, and a pawl adapted to engage a series of teeth on the plunger.

A Clean Out for Drainage Pipes. 496,561. Robert Garvie, Hartford, Conn. This invention comprises a body part having an interior flaring seat, a cover having a tapering edge ground to the seat, a central projecting stem on the outside, a cap provided with a threaded part engaging a corresponding threaded part on the body part of the clean-out, an opening through which the stem extends, and the device adapted to receive a tool for removing the cover.

A Tile or Brick Machine. 496,779. Egbert M. Freese, Plymouth, Ohio. This invention comprises a casing, a rotatable screw propeller or conveyor located therein, a rotatable shaft located above and at one side of the propeller or conveyor shaft, provided with a series of fingers or teeth, projecting between the spirals of the conveyor or propeller.

A Street Roller. 496,794. Assigned to Edward I. Pope, Moreland, Ill. This invention comprises a frame, a roll journaled in the frame, an arch secured to the frame, a circular iron or track, the brackets by which the circular iron or track is secured to the arch, a beam or swinging frame pivoted to the arch, and to which a draft tongue is secured, and friction rollers secured to the beam or swinging frame, and which bear upon the track.

An Automatic Operator for Drawbridge Gates. 496,893. Ralph L. Paddock, Philadelphia, Pa.

A Garbage Vessel. 496,917. Geo. B. Sweger, Chicago, Ill. This invention comprises a main portion for holding the garbage provided with a series of holes in the bottom, a lower portion adapted to inclose the lower end of the main portion for a short distance, the two portions fitting together easily and being seperable from each other, and one portion being provided with lugs to regulate the distance which the main portion enters the lower portion, the hole or either portion being adapted to be moved from place to place.

A Brick Cutting Machine. 496,982. Jacob A. Snell, Barrington, R. I. This invention comprises a slotted stationary cutting bed and a series of mounted cutters arranged to pass into the slots, an extensible table composed of a series of connected sections onto which a number of brick blanks are simultaneously delivered, means for opening and closing the table, and a pusher or discharging plate arranged to force the series of blanks from the table.

A Brick Cutting Machine. 496,983. Jacob A. Snell, Barrington, R. I. This invention comprises a movable cutting frame and a fender or guard plate arranged to be forced below the bed level by the action of the cutter-frame.

A Street Sprinkler. 497,074. Assigned to H. G. Stiebel, Jr., and A. C. Stiebel, St. Louis, Mo. This invention consists of a tank having an out-let pipe at the bottom thereof, a regulating valve in the pipe, a conveyor-cylinder communicating with the out-let pipe, a spiral conveyor within the cylinder, out-let openings leading from the conveyor-cylinder having a combined sectional area less than that of the inlet openings to the cylinder, and a sprinkling device connected with the out-let openings.

V. H. Lockwood, Patent Att'y.
Indianapolis, May 20, 1893.

PERSONALS.

C. H. Ladomus has been elected city engineer of Chester, Pa.

Mr. G. M. Norris has been elected city engineer of Madison, Wis.

Mr. John G. Zane has been elected city engineer of Escanaba, Mich.

Mr. D. H. Bartholomew has been elected engineer of Lansing, Mich.

Mr. O. R. Rauchfuss has been appointed city engineer of Joliet, Ill.

Mr. J. Trumbor has been elected town engineer of Glenwood Springs, Colo.

Mr. W. B. Howe has been appointed city engineer of Concord, N. H.

Mr. Wm. Jackson has been reappointed city engineer of Boston, Mass.

Mr. T. N. Reiter has been appointed city engineer of Ishpeming, Mich.

Mr. T. H. Davenport has been appointed city engineer of Jacksonville, Ill.

Mr. L. W. Leete, of Huntington, W. Va., has been re-elected city engineer.

Mr. J. E. S. Pryor has been elected city engineer of Hagerstown, Md.

Mr. H. H. Pendleton has been appointed city engineer of Independence, Mo.

Mr. John C. Chase, M. Am. Soc. C. E., Wilmington, N. C., has recently been appointed a member of the North Carolina State Board of Health.

Mr. Thomas Danger has been appointed superintendent of public works in Port Huron, Mich., and Mr. T. W. Rogers reappointed city engineer.

Mr. F. A. Dunham, of Plainfield, N. J., has been re-elected city engineer of Dunkirk, N. Y. Mr. Dunham has recently opened a branch office at Pittsburgh, Pa.

Mr. Samuel G. Artingstall has been appointed city engineer of Chicago, Mr. O. H. Cheney superintendent of sewers, Mr. John Fitzsimmons superintendent of water-works, and Mr. Hiram J. Jones commissioner of public works.

LETTERS FOR THE PUBLIC.

A BRICK LINER FOR STREET CAR RAILS.

To the Editor of Paving and Municipal Engineering:

SIR—I notice on page 275 of your May number, a cut of a section of street railway track showing a cement filling for grooves inside of the girder rail before the paving joins the rail. I have done a large amount of track paving in this city, using various materials for this filling of grooves.

I have now introduced a brick liner in place of cement or other materials and it fully meets all requirements. Most of the track work now being done here is reconstruction, made necessary by the change from horse to electric power. The 90-lb. girder rail is used, and the reconstruction is carried on without stoppage of cars. Under these circumstances the cement would be jarred out by the running of the cars, and it is difficult at any time to make the cement adhere to the iron.

The liner which I use is made of clay molded to fit the rail and burned the same as brick. It is made in sections of the same length as the paving block and is placed in the groove just ahead of the paving, filling the groove and making a solid perpendicular bearing for the paving blocks against the rail. I have used wooden strips for the same purpose, but they are objectionable, as they are liable to decay. This liner is imperishable and has the advantage of being solid as soon as put in, while the cement filling must have time to set and become hard before it is really serviceable. A good many miles have been prepared in this way, and all who have seen it consider it the most practicable plan for filling up these hollow places in the rail where tracks are to be paved. *N. B. Abbott.*

Columbus, O., May 13, 1893.

ROAD-BED OF STREET RAILWAY TRACKS.

To the Editor of Paving and Municipal Engineering:

SIR—In your April number I read a very interesting article on "Damage to Brick Streets by Electric Cars," by one of our brother engineers of this city, Mr. F. W. Cerny. I concur with him in his views on this subject so far as he goes, and as I have made careful observations myself for some time past, I will make some suggestions which, I believe, would save railway companies a great deal of annoyance and expense.

In excavations I would go at least twelve inches below the bottoms of the ties and grade this subgrade so that a cross section of it under each track would be V-shaped, being about three inches lower in the center than at the ends of the ties.

At the vertex of the V I would sink a common two-inch drain tile, running longitudinally along the center of the track; this I would connect with a drop or other conduit at the bottom of the grade. On the sub-grade thus prepared I would spread broken stone or gravel to a depth of twelve inches and then lay the ties on these.

The main point which I present here is the use of the drain tile, which, being capillary in its action, draws all the moisture from the foundation of the track.

In support of my argument I will state that on level grades where the water has but little chance to get away, we find the track the most difficult to maintain, while on steep grades where the water runs off it requires comparatively little attention. Many railroads are making use of drain tile in the manner above suggested in cuts and other places and find it obviates the difficulty in maintaining the tracks to a marked degree.

H. M. Gates.

Columbus, O., May 8, 1893.

COMPARATIVE COST OF PAVED STREETS.

To the Editor of Paving and Municipal Engineering:

SIR—I send you an article published lately in a Memphis paper. It bears upon two or more articles in the last number of PAVING AND MUNICIPAL ENGINEERING.

The last paragraph would seem to show that Major Geo. B. Fleece falls very far short of the facts in his estimate. But if this is so what can not be said in condemnation of City Engineer Meriwether's statement that:

"Where traffic is heavy and continuous and cost and noise are secondary considerations, durability with least repairs being a prime consideration, all authorities agree that first-class granite pavement stands first."

I have taken the trouble to ask Major Meriwether if he meant this statement to apply to Memphis, as, of course, any reader would infer. He claims that he thinks it holds for Memphis!

It seems to me to be very absurd to claim, as he does, that the cost of any extra inconvenience due to repairing and relaying asphalt or brick can justify such a great excess of constant expense to vehicles and horses due to granite which is laid and kept up for any given time only at far greater expense than is necessary for brick or asphalt.

J. M. Heiskell.

It is not sufficient to compare the cost of paving alone. To properly compare pavements, we must consider the object for which they are laid, and their degree of success or failure in effecting that saving to traffic which is sought.

It is indeed remarkable that so very many writers upon this subject of pavements should never consider at all the prime object of pavements.

Manifestly, the true object is to save cost of using streets. This object the pavement accomplishes only when it lessens the cost of traction or rolling friction per ton of load hauled.

Hub-friction-cost and grade-cost-proper should be excluded from the cost of pavements since no pavement can affect them.

To justify or pay for itself the pavement must save more per square yard in pounds per ton of pull or tractive force required than it costs per square yard to lay and maintain. This amounts to saying that the saving to vehicles, horses, etc., for which the pavement is laid, must be greater than the cost of the pavement itself, or else no saving is effected.

The authorities give, as the result of experiment, the following pulls in pounds per ton of load for the pavements here conpared:

"Asphalt, 15 pounds at all speeds. Brick, not given. Granite, at a walk, 33 pounds; at a trot, 66 pounds. Stone block, at a walk, 40 pounds; at a trot, 117 pounds.

These figures include hub friction, say about 3 pounds. Hence we have tractive force required on asphalt, 12 pounds; (required on brick, 18 pounds); required on granite, 36 pounds; required on limestone, 60 pounds. Each pound of pull costs, say x cents for the whole traffic in, say, 20 years. We can not say how large x is for any pavement, but we can say how large it must be to justify the laying of one pavement instead of another. In reality x is greater for brick than for asphalt, and greater still for granite and limestone block, but if we consider x as the same for all, we make safer for the purposes of the comparison the figures, 12, 18, 36 and 60 pounds. The problem is to find the comparative cost in 20 years of streets in Memphis, including cost of pavements, when:

1. Paved with limestone—"ordinary stone blocks"—at $2.15, and relaid at $2.15 in 10 years. Cost without repairs, 60x plus $10.75 per square yard, 6 per cent. compound interest on cost of pavement in 20 years. No interest on cost of traction.

2 Paved with "granite blocks" at $4.35, without repairs. Cost in 20 years at 6 per cent. compound interest, 36x plus $13.95 per square yard. No interest on cost of traction.

3. Paved with brick at $2.75, without repairs and relaid at ten years at $1.50. Cost at 6 per cent. compound interest in 20 years 18x plus $11.50 per square yard. No interest on cost of traction.

4. Paved with asphalt at $2.90, including five years' guarantee, then 9 cents per yard per year for fifteen years. Cost at 6 per cent. compound interest, 12x plus $11.40. No interest on cost of traction.

Excess cost of limestone over granite, 24x plus $3.20=saving of granite over limestone.

Excess cost of granite over brick, 18x plus $2.45=saving, etc.

Excess cost of limestone over brick, 42x plus 75 cents=saving, etc.

Excess cost of granite over asphalt, 24x plus $2.55=saving, etc.

Excess cost of limestone over asphalt, 48x plus 65 cents=saving, etc.

Taking the actual case in Memphis, where 50,000 yards of granite at a cost of $13.95 in twenty years have absorbed the cost of 65,000 yards of limestone, 60,700 yards of brick or 61,300 yards of asphalt, we find that if the partial substitution of the granite for the limestone is justifiable the saving due to the 50,000 yards of granite must, at the very least, pay for paving the remaining 15,000 yards with limestone, or x must be 13⅓ cents. If x is as much as 13⅓ cents, then even where granite saves nothing brick would save on the 65,000 yards in 20 years $292,395, and asphalt would save $352,475. If, however, we take the cost year by year for twenty years of, say 100,000 square yards of street surface paved with limestone at $2.15 ($217,500), or with 49,425 square yards of granite at $4.35 ($217,500), and the remainder limestone, 50,575 yards, at $2.15 ($108,736), or with 78,180 square yards of brick at $2.75 ($217,500), and the remainder, 21,820 yards limestone at $2.15 ($46,913), or with 74,140 yards asphalt at $2.90 ($217,500), and the remainder limestone, 25,860 yards, at $2.15 ($55,599), we find as follows: Cost of asphalt and limestone (12x plus $2.90) times 74,140 plus (60x plus $2.15) 25,860, plus 6 per cent. on any excess over cost of the cheapest surface of the four. Cost of 78,180 yards brick, plus 21,820 yards of limestone at $2.15 (18x plus $2.75), 78,180 plus (60x plus $2.15) 21,820, etc. Cost of 49,425 yards granite and 50,575 yards limestone at $2.15 (36x plus $4.35) 49,425, plus (60x plus $2.15) 50,575, etc. Cost of 100,000 yards limestone (60x plus $2.15) 100,000, etc. For first year: Asphalt, $324,217; brick, $320,070; granite, $432,742; limestone, $335,000.

The traffic is supposed to be such as would make x equal 1 cent per pound pull per yard per year.

Five years' cost would be:

	Five Years.	Ten Years.
Asphalt	$422,217	$578,449
Brick	429,015	565,440
Granite	663,014	996,715
Limestone	591,509	967,992

Relaying brick at end of ten years, we have at twenty years:

Asphalt	$ 889,309
Brick	1,024,329
Excess cost of brick	$ 135,020
Asphalt	889,309
Granite	1,865,220
Excess cost of granite	$ 975,911

These figures may be somewhat unfair to brick, but if we compare brick and asphalt separately with granite, 100,000 of each, including cost of laying, cost of using and interest at 6 per cent. on excess cost to the end of each year for *ten* years, we find that asphalt, at $3 for ten years, saves about $558,000, while brick at $2.75 for ten years saves $524,000 over granite at $4.35 for ten years. Brick at $2.42 will save $583,000 over this estimated cost of granite. *J. M. Heiskell.*

Memphis, Tenn., May 5, 1893.

SELECTIONS FROM THE PRESS.

LONDON WATER SUPPLY SYSTEM.

London, with its teeming millions of citizens, consumes on an average over 200,000,000 gallons of water every day, not taking into account the special waters, mineral waters, etc., the consumption of which is considerable. This supplies a population estimated at nearly 5,500,000, as the water company supply many whose residences or work places are outside of the municipal boundaries. About 60 per cent. of all the water used is taken from the Thames, some 30 per cent. from the river Lea and the remainder from springs or wells.

As may be imagined the water from such a source is not naturally of the purest, and yet its wholesome condition is of the utmost importance to the health and even the life of this vast congregated mass of humanity. All the companies supplying water have therefore great subsidence reservoirs in which the water is first allowed to settle its coarser filth and then huge filter beds through which it must pass on its way to the service pipes.

The depth of the materials of which the filtering bed is made up varies from a total of eight feet at the Chelsea water-works to three feet six inches at the East London water-works. In the materials employed by the Grand Junction Company at the Kew Bridge water-works there is a foot of coarse gravel, six inches of fine hoggin (screened gravel) and three feet of sand. A good rate of percolation is four inches an hour, so that it would take about nine hours for the water to pass through a sand bed of this depth.

The nature of the material used for filtering also varies slightly. Without going into unnecessary detail it may be sufficient to say that a layer of sand, varying from two feet to four and one-half feet in depth, forms the surface in each case. Layers of shells, hoggin, coarse gravel and bowlders, or some of these materials, form the lower strata of the filter bed; but it seems to be universally agreed that the surface of the bed is a more important factor than the lower layers.

The late Sir Francis Bolton, who was the water examiner appointed under the provisions of the metropolis water act, 1871, in his work entitled "London Water Supply," refers to a curious fact in connection with filtration. He observes that, according to theory, a well-ascertained rate of the destruction of the efficiency of the filter bed could be calculated, assuming that filtration were merely a mechanical process, but that in practice the filter beds retain their efficiency to a markedly greater extent.

His explanation is that filtration is a chemical as well as a mechanical process, and that in passing through the filter bed the water is not only strained, but oxidized. It is well known that running water has a self-cleansing power, and that the exercise of that power is increased when the body of water is broken up by falling over either rocks or weirs. Sir Francis Bolton simply suggests that the interstices in the filter bed, containing globules of air, according to the well-known theory that all solid bodies attract about them an atmospheric film, practically compel the water to pass through a chemical filter of compressed oxygen and nitrogen, which obligingly relieves the water of its impurities by chemical changes as it passes. Thus the frisky comma or the lively typhoid germ may not break its neck by passing over a weir, but merely prolong its existence to be deprived of sustenance by oxidation, or, in other words, to be starved to death by a surfeit of life-giving gas.

The water companies observe the flow through the filter beds, and at frequent intervals, suggested by experience, cause the surface of the sand to be removed for cleansing, and at longer intervals the whole bed to be entirely renewed.—*Water and Gas Review, London.*

A NATURAL PORTLAND CEMENT.

A discovery of great commercial importance to the Australasian colonies has been made on Maria Island, a dependency of Tasmania, consisting of a practically inexhaustible deposit of carboniferous limestone which, upon being treated, yields in itself, and without any admixture, a Portland cement of very high quality. The certificates of many colonial experts who have tested this cement leave no doubt whatever as to its valuable character and properties. Mr. Henry Faija, M. Inst. C. E., has just completed an experiment with this peculiar material at the Rugby and Newbold cement works. Two tons of raw material were treated by the dry process used at Rugby with highly satisfactory results. The analysis shows this material to be a normal uncalcined cement, and that when calcined it bears favorable comparison with the best English cement. The cement made from this raw material was submitted hot from the mill to very severe tests by Mr. Faija, and did not show any indication of contraction or expansion. It has a slightly greenish tinge. It is heavy, weighing 113 lbs. per bushel, and having a specific gravity of 3.152. It is of a slow-setting character, and after lengthy immersion in water attains the hardness of basaltic rock.

The average tensile strength attained by Mr. Faija was as follows: Neat cement—Average, 463 lbs. per sq. in. from five briquettes seven days old; average, 536 lbs. per sq. in. from five briquettes 14 days old; average, 646 lbs. per sq. in. from five briquettes 28 days old. Sand tests—One part of cement and three parts of sand. Average 150 lbs. per sq. in. from five briquettes 7 days old; average 258 lbs. per sq. in. from five briquettes 28 days old. Tests made at the Rugby and Newbold cement works from this cement, after three weeks' exposure to the air, gave an average tensile strength of 620 lbs. per sq. in. from briquettes 7 days old. This cement was also tested by the Patent Adam Stone Co., at the Greenwich works under powerful hydraulic presses. With one part of cement and three parts of granite they produced a stone certainly superior to any made with English cement. Samples tried with neat cement produced specimens so extremely hard that, by the usual process of stoning, a high polish was given to them, and this they could not obtain with English cements. From the accounts of geologists and other experts who have visited Maria Island, the deposits of this material appear to be inexhaustible, and there is every reason to believe that the establishment of cement works in Tasmania to deal with these deposits will prove a great benefit to that and the neighboring colonies, as these works should produce all the large quantities of cement hitherto imported from Germany and England for public and private works, and produce it, moreover, at a lower cost.—*The London Times.*

THE TEE RAIL AND BRICK PAVING.

A tee rail with vitrified brick paving is a very desirable construction for some localities, and we are frequently asked how to design such a construction, when restricted to the use of a rail not over 3½ or 4 inches in depth. We confess that we are not able to answer the question without the employing of a stringer or chairs on which to place the rail, but as very unsatisfactorily results have been obtained where chairs have been employed, their use can not be recommended. We should be very glad, indeed, to be able to recommend a durable construction under the conditions named, but we do not see how it is possible, and the only safe way out of the difficulty is to employ a rail from 6 to 7 inches in depth, as is being done in very many localities with very satisfactory result. In this connection we should also recommend that a substantial concrete foundation be in all cases provided, on which to place the brick paving, and that an equally substantial foundation be placed under the track construction, but whether the concrete should be placed between the ties only or between the above, is a question which local conditions must settle. If the ties rest in a concrete pocket, moisture will accumulate, and cause the wood to decay. If the tie is entirely inclosed, it will be liable to be attacked by dry rot, so that the character of the wood employed and the climate must regulate these questions. If anyone is able to suggest a design that will remedy all the supposed difficulties in the case, they will confer a great favor upon the railways of some of our Western towns and cities.—*Street Railway Journal.*

TROLLEY MAIL CARS.

The idea of adapting electric street cars to local mail service in large cities seems to be extending. In Cleveland, Ohio, preparations are being made to introduce electric mail cars on the street railroad lines in order that the mail matter to and from the outlying sections of the city may be more expeditiously delivered and collected. The idea is to carry mail clerks on each car who will work on the car while it is in motion, instead of at the office. It is obvious that a great saving of time will be effected, and the needs of business in large cities demand better and quicker facilities for handling mail matter. St. Louis has tried the experiment and found it very convenient, and there is no reason at all why the idea should not be adopted in all large and enterprising cities. Even if rapid transit can not be carried out to its limit on account of crowded streets, time would be saved by running mail cars and the work of mail assorting, distribution, etc., carried on *en route.*—*Electrical Age.*

PYRITE REFUSE FOR STREET PAVEMENTS.

About a year ago the street department of Charleston, S. C., made an experiment of laying out a portion of the roadway of Spring street with the cinders of pyrites. This experiment, which was attempted on a very small scale, proved a great success, and now the department is repeating the operation in Archdale street, between Queen and Clifford streets.

The cinders are obtained from the phosphate works adjacent to Charleston, and when mixed properly form a chemical compound that is hard and durable. The roadway in Spring street that was laid out in pyrites cinders has proved a great success, and it is anticipated that the new venture will prove the same.

Several layers of the cinders are required in laying the roadbed, and when it is properly stamped down the cinders form a hard, compact mass that is nearly as lasting as rock.—*Charleston News and Courier.*

MACHINERY AND TRADE.

BRICK REPRESSING AND REPRESSES

Messrs. J. W. Penfield & Son, of Willoughby, O., have in the last few months issued five new catalogues, each describing a distinct type or class of brick-making or clay-working machinery. They now have under way the issuing of two more catalogues, a book of autograph testimonials, a pamphlet on testing clays, etc. Their catalogues are all exceptionally fine specimens of artistic printing. One of their latest publications is devoted to brick repressing and represses, which not only tells all about their own machinery of this type, but gives some useful general information, as follows:

"Although the repressing of brick has been practiced for many years, it has been only at a comparatively recent date that this process has met with anything like general adoption. Now, not only the finest grade of plain and ornamental front brick, but also a large percentage of the best paving brick, are repressed, and the number of manufacturers repressing a portion or all of their product is rapidly increasing. Nor is this surprising when we consider the various advantages thus secured.

"1st. From the plain brick or blocks formed by the dye working, or sand moulding brick machines, can be produced fine front brick in plain and ornamental shapes, and fancy terra-cotta blocks in great variety, and of the best quality.

"2d. The capabilities of any manufacturer for producing a wide range of products is greatly increased, for many desirable forms of ornamental ware, owing to their peculiar configuration, could not be produced with a die working or sand moulding brick machine alone without the aid of a repress.

"3d. The repressed bricks or blocks in plain or ornamental shapes have largely increased value, insuring an increased percentage of profit, even taking into account the cost of repressing.

"4th. The angles, surfaces and edges of the brick or blocks after repressing are precise and perfect, and exact uniformity in size is secured; a desirable feature in either building or paving material.

"5th. By repressing, greater density and solidity of ware is secured. Air bubbles and other like defects in brick are removed and laminations corrected to a great extent. The strength and durability of the ware is largely increased and the capacity for absorbing fluids reduced, making repressed brick especially suitable for paving purposes.

"6th. Some popular patented forms of paving brick must be repressed to secure the desired shape and configuration.

"7th. Manufacturers can stamp their trade mark or address on each brick, which may prove a valuable as well as a free advertisement.

"The above considerations clearly show that there are valuable advantages secured by repressing fine clay products, and answer the question, 'Does repressing pay?' most decidedly in the affirmative."

NEW ASPHALT PAVING WORKS.

The Wasatch Asphaltum Company started up its big mills on the 10th inst. and invited many of our prominent citizens, including a number of the city council, to be present on the occasion. A nice lunch was provided and a number of speeches made commendatory and explanatory of the enterprise. These works have a capacity for reducing to powder 100 tons of asphaltic limestone in ten hours, and have been erected for the paving work to be done in this city as well as to prepare mastic blocks for shipment to the east, where this kind of asphaltum is in large demand.—*Salt Lake Journal of Commerce.*

PICTURES FOR BRICK MANUFACTURERS.

"Chambers' Picture Book for Brick Manufacturers" is the title of a very handsome new catalogue issued by the Chambers Brothers' Company, builders of brick-making machinery, Fifty-second street and Lancaster avenue, Philadelphia. It is very freely illustrated, as the title indicates, giving pictures of the different kinds of brick-making machinery manufactured by this company. In referring to these, they say: "To the many friends who are using our machinery these engravings are simply a representation of objects with whose merit they are already familiar, while to those who are not already our customers we would say that they are so far as possible faithful reproductions of the machine as built. We make no finely drawn contracts over which to 'split hairs' at time for settlement, the question of acceptance or rejection resting simply upon the fact that the customer, after trial, either wants or does not want the machine offered."

THE VALUE OF PAVEMENTS.

The question of what kind of pavement will most increase the value of abutting property is one of great importance to property-owners. The Warren-Scharf Asphalt Paving Company give some facts relating to this question in their advertisement in the present issue.

NOTES.

Thomas Carlin's Sons, of Pittsburgh, have issued Catalogue F, illustrating their large line of sewer castings, gutter crossings, road rollers, crushers, contractor's tools, etc.

R. C. Pope, No. 806 Chamber of Commerce, Chicago, has issued a new catalogue, giving much information regarding his reversible roller, the improvements in its construction, and its operation. The catalogue contains the testimonials of many engineers and contractors who have used the machine, and fully explains the principle on which the Pope roller is made.

Geo. E. Briggs, No. 96 Fourth avenue, Pittsburgh, has issued a little pamphlet giving full information regarding his lock-joint brick and system of masonry, which will, he claims, afford a reduction of 33⅓ per cent. in material, labor and weight, though retaining all the strength and other advantages of the old system of masonry. This invention has received the commendation of some of the foremost engineers, architects and builders in the United States.

IMPROVEMENT AND CONTRACTING NEWS

PAVING.

CONTEMPLATED WORK.

Main street, Marshalltown, Ia., will probably be paved.

Fargo, N. Dak., is discussing the street paving question.

Fostoria, Ohio, is agitating the question of street paving.

There is talk of paving Main street, Piqua, Ohio, with brick.

Mentor avenue, Painesville, Ohio, will probably be paved with brick.

The paving question is being actively discussed at Grand Forks, N. D.

Pomeroy and Middleport, Ohio, are agitating the question of paving their streets.

The village of Salamanca, N. Y., is agitating the question of paving its main street.

Brazil, Ind., is talking of paving Main street with brick and macadamizing other streets.

Madison, Wis., will probably issue bonds for the purpose of making permanent street improvements.

The question of paving the streets around the city square at Carthage, Ill., is being discussed.

The city council of Butte City, Mont., has decided that the principal streets of the city must be paved.

It is proposed to lay out streets and avenues in the region between the Zoological Park and the Soldiers' Home, Washington, D. C.

The estimated cost of the proposed improvements in the lower wards of Allegheny, Pa., is $4,000,000. This includes the raising of the whole lower district.

D. P. Packard, secretary of Greenville, Pa., writes that the outlook is that the majority of the streets of that borough will be paved with brick in the near future.

The people of Robinson, Tex., are trying to raise money to macadamize the Waco and Robinson road. They have appointed committees for the purpose. This road is six miles long. It is understood that if the people will raise $600 to the mile the county will give the balance.

New Orleans property owners are petitioning for concrete gravel pavement on Arabella street and Rockport, Me., Quincy, Mass., or Belgian block granite pavement on Lafayette street.

The board of public works of Milwaukee, Wis., has been petitioned for the construction of an asphalt pavement with a concrete foundation under the new law providing for time payments. A number of streets have been ordered paved with cedar blocks. Forty miles of sidewalks will be constructed this season.

Burnside street, Portland, Ore., will be improved as far out as Twenty-eighth. Up to Fifth street the thoroughfare will be covered with timber 6x6 inches, and thence to the terminal point with timber 5x5 inches. The cost of laying the timber and the material will not exceed $20,000. More or less grading will need to be done, but none of it heavy and costly.

A. B. Phillips, clerk of Ashtabula, Ohio, writes that the question of paving narrower driveways on residence and suburban streets is being quite fully discussed. It seems to be the general opinion that narrow driveways from twenty-two to twenty-six feet wide are the proper thing for such streets, the arguments in favor being the lessening of expense of construction and keeping in repair, the general appearance of the street, and the chance for placing water mains, gas pipes and sewers outside of the paving.

CONTRACTS TO BE LET.

Bids are wanted for paving at Wilkes-Barre, Pa.

Walnut street, Barnesville, Ohio, is to be paved with brick.

Bids are wanted for paving on various streets of Dayton, Ohio.

Nine or ten miles of New Orleans' streets are to be paved in the near future.

A large amount of street work has been ordered done in Mt. Vernon, Ohio.

North Salina street, Syracuse, N. Y., is to be paved and otherwise improved.

Plans are being made for the paving of High and Main streets, Hamilton, Ohio.

Porter avenue, Buffalo, N. Y., is to be widened and the whole street paved 100 feet wide with Trinidad asphalt.

A number of six-foot paving brick sidewalks have been ordered in Rock Island, Ill.

The sum of $142,000 will be devoted to brick paving at Niagara Falls this summer.

Estimates have been made for paving on Monroe and Chicago streets, Coldwater, Mich.

South Park street, south of Bridge street, Streator, Ill., is to have a thirty-foot paved roadway.

Ordinances have been passed providing for the improvement of various streets in Seattle, Wash.

Sealed proposals will be received by the city clerk of Fostoria, O., until June 12, for improving Main street.

Pottsville, Pa., is planning for more paving. Vitrified brick will probably be used instead of granite blocks.

Ordinances have been passed authorizing the repaving and sewering of a large number of Philadelphia streets.

The city clerk of Warsaw, Ind., writes that the city is in need of three or four car loads of street crossing stones.

The city engineer of Brainerd, Minn., will soon invite bids for the granite curbing and cedar block paving of sundry streets.

An ordinance has been passed in Trenton, N. J., providing for the paving with brick of Jackson street from Market to Livingston street.

H. H. Wagoner, city engineer of Huntington, Ind., writes that the council has ordered that grades be established on every street in the city.

Proposals will be received at the office of C. A. O'Brien, Delphi, Ind., until June 6, for the improvement of Front street, including sidewalks and gutters.

Resolutions have been passed for the grading and paving of various streets and the construction of a number of brick and cement sidewalks in Indianapolis.

A. B. Philips, clerk of Ashtabula, Ohio, writes that the council has determined on the improvement of Pine, Sibley, Hume and Pacific streets and Fairfield avenue.

W. C. Campbell, city secretary of Palestine, Texas, writes that the city will contract for about two and one-half miles of stone, cement or asphalt sidewalks to be paid for in bonds at par, bonds to bear 6 per cent. interest.

Sealed bids will be received at the office of the city clerk of Canton, Ohio, until June 12 for the grading and paving with vitrified brick on broken stone foundation and constructing drainage and curbing, on North Market street, from West Lake street to Aultman avenue.

Sealed proposals will be received by the city clerk of Keokuk, Ia., until June 5 for grading about 4,300 cubic yards, curbing, 4,500 lineal feet, and brick paving, 9,200 square yards.

Sealed proposals will be received by the town clerk of Austin, Ill., until June 16, for the improvement of Ontario street from Central avenue to Willow avenue in the town of Cicero.

R. B. Dennis, clerk of Des Moines, Iowa, reports that bids will soon be received by the board of public works for about five miles of brick paving in addition to the fourteen miles now under contract.

Sealed proposals will be received by the sidewalk committee of Ludlow Grove, O., until June 8, for the construction of a four-foot cement sidewalk on both sides of Baker avenue, from Carthage to its western termination.

Sealed proposals will be received until June 5 for the grading, curbing and paving with brick Second and Third streets, from Main to Johnson streets, and Fourth, Fifth and Sixth streets, from Main to Blondeau, Keokuk, Iowa.

B. R. Morton, city engineer of Newport, Ky., reports the following streets to be reconstructed and paved with brick: Washington Avenue, from Third to Eleventh streets; York street, from Third to Eighth streets; Isabella street, from Fourth to Ninth streets, and Fourth street from York to Brighton streets. Ninth street, from Mill street to Overton street, is to be reconstructed and macadamized.

CONTRACTS AWARDED.

Geo. McBride, assistant city engineer of South Omaha, Neb., writes that contracts have been awarded Parks & Co. for 6,987 square yards of vitrified brick on concrete at $1.86 per square yard, and for 3,000 feet Colorado sandstone curbing at 60 cents per foot.

Geo. T. Day, clerk of Union City, Ind., writes that the contract for grading, graveling, construction of brick sidewalk, curbing and guttering on High street from Hickory to Pearl street, has been awarded to D. A. Williams at $2.28 per running foot of street.

SEWERAGE.

Nearly $60,000 will be expended this season on a system of sewers for Marinette, Wis.

H. H. Wagoner writes that William Shields, of Chicago, has been engaged to assist the city engineer in making a plan of sewerage for Huntington, Ind.

CONTEMPLATED WORK.

The common council of Kaukauna, Wis., is considering the matter of putting in a system of sewers that will cost $7,000.

Paris, Tex., is agitating a sewer system.

Jamaica, L. I., is contemplating a system of sewerage.

Faribault, Minn., will probably put in a system of sewers soon.

Springfield, Ohio, is agitating the question of a better sewerage system.

A number of sewers will probably be built soon in the Seventh ward, Toledo, O.

A sewerage system is among the probabilities of the near future for Watertown, Wis.

It is estimated that the proposed sewer system at Cortland, N. Y., will cost $103,990.80.

The council of Chatham, Canada, is considering the advisability of putting in a $100,000 sewerage system.

City Engineer Hoff, of Reading, Pa., is engaged in preparing plans for a $100,000 sewage disposal plant for the city.

The question of a belt sewer to cost upwards of $200,000 is a matter of great interest to residents and property owners living in the eastern and southern parts of the city of Terre Haute, Ind.

Jno. F. Maloney, clerk of Dunkirk, N. Y., writes that the city may construct a 4½-foot sewer in and along the bed of an open creek running through the eastern part of the city. The estimated cost is $20,000.

CONTRACTS TO BE LET.

Gardner, Mass., will issue bonds for $50,000 for sewer purposes.

Plans for a sewerage system at Alliance, Ohio, are being prepared.

Another extensive sewer will be put in the east side at Portland, Ore.

A system of sewers has been decided on as a necessity for Plymouth, Mass.

Proposals will be received until June 5 for making modifications in the sewer system at David's Island, N. Y. H.

Proposals are wanted until June 5 for the construction of a sewer system for the southern sewer district of Marion, Ia.

Maps and plans have been prepared for the new sewer which is needed so much in the east end of the city of Newark, N. J.

The city engineer of Hamilton, Ohio, is engaged in preparing plans for a complete and comprehensive sewerage system for the city.

City Engineer Ross, of Rutland, Vt., is at work on a map of the sewerage system of the city. Several new sewers will be laid this summer.

A resolution has been passed by the council of Youngstown, Ohio, deeming it necessary to construct a sewer with the necessary catch-basins, man-holes, flush holes and house connection pieces, etc., in Ridge street from Wallace to Plum streets.

J. C. Thompson, city clerk of Canton, Ill., reports that the council has authorized the issuance of bonds for ten thousand dollars for sewer construction.

D. P. Packard, secretary of Greenville, Pa., writes that plans and specifications for a sewerage system for the borough are on file, and bids will be wanted at an early date.

A. B. Philips, clerk of Ashtabula, Ohio, writes that petitions for sewers on Parsons, Sherman, Chestnut, Wilcox, Gary and Tyler streets have been granted by the council.

Sealed proposals for the construction of about 3,256 feet of pipe sewers, varying from 12 to 18 inches in diameter, will be received by the city clerk of Marshalltown, Ia., until June 12.

W. L. Calkins, of Emporium, Pa , reports that the borough council have employed J. A. Seymour, of Bradford, Pa., to make a survey and estimate of cost of laying a sewer. The question of bonding the town for sewer construction will be submitted to the taxpayers.

Edward H. Cole, village clerk of Nyack, N. Y., writes that the board of trustees of the village have appointed a board of sewer commissioners, of which Cornelius DeBaun, who will proceed to prepare a plan of sewerage for the approval of the state board of health, is president.

Alexander Potter, of New York City, is engaged in making surveys, plans and specifications for a complete system of sewers, and also establishing grades throughout the city of Martin's Ferry, Ohio. There are twenty-eight miles of streets, much of which will be sewered at once.

Sealed proposals will be received by H. E. Allison, medical superintendent Matteawan state hospital, Fishkill Landing, N. Y., until June 15 for the construction and finishing of about ten thousand feet of 12-inch vitrified pipe sewer from the Matteawan state hospital to and into Hudson river.

City Engineer Rosewater, of Omaha, Neb., submitted the following list of sewers, which he deemed advisable to construct out of the proceeds of the $100,000 bonds voted last fall for main sewers: Main sewer on Valley street from Tenth to Eighteenth street, approximate estimate of cost, $21,137; South Twenty-first street sewer, south extension, $13,045; Dorcas and Nineteenth streets sub-main extensions from Twenty-first street, $9,420; mains in Grant street district already recommended and agreed upon, $3,000; special sub-main, Burt street, from Twenty-fourth to Twenty-fifth street, $450; Chicago street sewer extension to river, $3,000; North Omaha main sewer, balance remaining, $49,948. Total, $100,000.

Sealed proposals will be received at the city clerk's office, Fort Dodge, Ia., until June 15 for the construction of sewers consisting approximately of 4,239 feet of 12-inch pipe sewer and 1,900 feet of 15-inch pipe sewer and about one hundred 6-inch house connections carried to the property line, also twenty-one manholes, eight lamp poles and one flush tank.

CONTRACTS AWARDED.

Geo. McBride, of South Omaha, Neb., writes that L. B. Stanley has the contract for laying about 3,100 feet of 24-inch pipe sewer at $1.19 per lineal foot; manholes at $2.95.

Houlahan, Griffith & Co., of Salt Lake City, have been awarded the contract for the proposed gravity sewer at that place. Their bid was $381,949.35. The other bids were: Andrew Rosewater, Omaha, Neb., $474,399.50; Jno. M. O'Rourke, Denver, $428,479.60; J. S. Morse & Son, Salt Lake City, $549,947.50; Sullivan, McDonald & Co., Salt Lake City, $431,883; Wickham Bros., Council Bluffs, Ia., $640,987.55; Ryan, Griffith & Co., Council Bluffs, $393,774.10; McConnell & Miller, Council Bluffs, $517,627.80.

The following bids were received for making complete sewerage plans for Niles, Ohio: Sam'l M. Gray, Providence, R. I., $1,000; J. H. Harlow, Pittsburgh, Pa., 2½ per cent.; J. Leland Fitzgerald, Schenectady, N. Y., $800; Alexander Potter, New York, $750; Geo. W. Sturdevant, Chicago, $750; Geo. E. Hersey, Youngstown, Ohio, $700; O. M. Gardiner, Jamestown, N. Y., $650; Albert Smith, Saltsburgh, Pa., $600; L. E. Chapin, Canton, Ohio, $600; J. C. Wright, Knoxville, Tenn., $460; E. Devalon Smalley, Syracuse, $300. The contract was let to Alexander Potter.

WATER-WORKS.

CONTEMPLATED WORK.

Seventy thousand dollars have been voted to improve the water system at Jackson, Mich.

Cadiz, Ohio, had a special act passed by the legislature allowing the city to issue bonds to the amount of $35,000 for the purpose of erecting water-works.

The water-works question is being agitated at Waupaca, Wis.; North Andover, Mass.; Howell, Mich.; Lowville, N. Y.; Creede, Colo.; Mt. Vernon, Ia.; Marshfield, Ore., and Gibson City, Ill.

CONTRACTS TO BE LET.

Proposals for water-works for Bradford, Pa., will be received until June 5.

Sealed bids for the pumping plant for the pumping station at Charlestown will be received by the board of metropolitan sewerage commissioners at its office, 110 Boyleston street, Boston, until July 1.

Proposals will be received until June 14, for a complete system of water-works for Hillsboro, Ohio.

The Grand Rapids (Mich.) board of public works has decided to lay about six miles of water mains this year.

San Diego, Cal., will issue $665,000 in bonds for the construction and acquirement of a system of water-works.

The board of public works of Grand Rapids, Mich., has decided to lay nearly six miles of water mains this year.

Sealed proposals will be received until June 13 for the construction of a system of water-works for Lake City, Minn.

Sealed proposals will be received at the office of J. H. Speer, Cochranton, Pa., until June 10 for the construction of water-works.

Surveys, reports and estimates for a water supply for the village of Silver Creek, N. Y., are being made by Alexander Potter, of New York City. Pumping from Lake Erie, from driven wells, and a gravity supply are talked of.

Extensive improvements will be made this summer on the water-works system at Terre Haute, Ind. Among them will be the construction of additional filters to cost $25,000, and will give the company a capacity of 6,000,000 gallons in twenty-four hours.

Water-works are to be built at Hogansville, Ga.; Farmville, Va.; Cotulla, Tex.; Lake Benton, Minn.; Spring Valley, Minn.; Lebanon, Ind.; Norwalk, Ohio; Bryan, Ohio; Cambridge, Ohio; St. Johnsonville, N.Y.; Glens Falls, N. Y.; Millvale, Pa.; Louisville, Colo., and Macomb, Ill.

C. G. Carlson, city clerk of Moline, Ill., writes that on the recommendation of the committee on fire, water and light the city council passed a resolution authorizing the purchase of a high-duty pump of 5,000,000 gallons capacity per day. The committee has made advertisement for proposals to be received until the 14th of June.

Jno. F. Maloney, city clerk of Dunkirk, N. Y., writes that proposals will be received until June 7 for extending the suction pipe and crib of the water-works further out into the lake. The work includes the furnishing and laying of about 5,200 lineal feet, 522 tons of 24-inch cast iron influent pipe and seven tons of special castings; also a submerged intake crib and a circular brick pump well 25 feet in diameter and 25 feet deep.

CONTRACTS AWARDED.

Geo. T. Day, city clerk of Union City, Ind., writes that the Knapp Supply Co. have the contract for 952 feet of six-inch water main at 71½ cents per foot, and 1,517 feet of four-inch main at 55¾ cents per foot.

The system of water-works contracted for at Rochester, Ind., will cost $33,574.71.

The Portland Water Company has been awarded the contract for putting in a system of water-works at Portland, Ind. The city is to pay an annual rental of $3,500.

BRIDGES.

The city clerk of Warsaw, Ind., writes that a forty-foot bridge will be built during the summer.

The building of a bridge across Grand river is being agitated at Chapel, Kent county, Mich.

Carroll county, Ind., will invest $54,000 in new bridges crossing Deer creek and the Wabash river near Delphi.

The Big Four Railroad may build a viaduct at Wood street, running from Third to Fourth streets, Cincinnati, O.

A proposition to build a highway bridge across the Missouri river at St. Charles, Mo., is agitated by J. H. Killmer, of Cleveland, O.

Bids will soon be wanted for a bridge across the Kaw river at Bonner Springs, Kan. Bonds for $13,000 will be issued for its construction.

A new railroad and wagon bridge across the Mississippi at the foot of Delaware street, Quincy, Ill., is agitated. Estimates are now being made.

The city council of Worcester, Mass., has authorized the county commissioners to spend $3,200 for a new steel or iron bridge over Kettle Brook at Leesville.

A new $100,000 bridge will be built at Franklin St., Evansville, Ind. The bridge will be put in by the county, the Evansville Department of Public Works providing the approaches.

Bids will be received at the county auditor's office, Columbus, Ohio, until June 12, for the construction of bridges and culverts on the Pleasant Corners and Stringtown free pike.

Adna Dobson, city engineer of Lincoln, Neb., writes that the "O" street viaduct over the railway tracks, for which contract has been made with the Milwaukee Bridge and Iron Works, is to have a total length, including approaches, of nearly 2,000 feet, a clear roadway of 25 feet and two 6-foot walks. It is to be built of iron and steel.

W. W. Morrison, recorder of West Knoxville, Tenn., reports that the city has contracted with Messrs. Johnson & Haynes for the masonry and grading of a bridge over railroad tracks connecting Ninth street with Sanders avenue, Knoxville. The contract is for $2,000. West Knoxville is preparing to issue $75,000 bridge and sewer bonds to run thirty years.

It is proposed to bridge Chouteau avenue, St. Louis, Mo., over the Oak Hill division of the Missouri Pacific railway. The St. Louis Terminal Company will bridge over its tracks at the crossing of the natural bridge road.

R. B. Dennis, city clerk of Des Moines, Ia., writes that the council has passed an ordinance providing for the building of a viaduct about 2,000 feet long over eight railroads, switches, etc., on West Ninth street. The city engineer is preparing plans.

Proposals will be received until June 7 at the office of Henry J. Caren, Columbus, Ohio, county auditor of Franklin county, for the construction of a 140-foot single span Platt truss. Bids will be received on June 6 for a double span Pratt truss over Big Darby creek.

Proposals will be received at the office of the board of bridge commissioners of St. Joseph county, South Bend, Ind., until noon, June 5, for the construction and erection of a through wrought iron bridge consisting of a single span 150 feet in the clear, between abutments.

The people of Jefferson City, Mo., are taking active steps to build a highway bridge across the Missouri river at that point in order to secure a connection with the Chicago and Alton and with the Missouri, Kansas and Texas road. It is proposed to build an electric line in connection with the bridge.

The projected rapid transit bridge between Cincinnati and Covington will be commenced this summer and the expectation is that it will be fully completed in two years. The bridge, which will be built with private capital, will cost about $2,000,000, and will touch the Cincinnati side of the river somewhere between Elm and Plum streets.

STREET LIGHTING.

Hagerstown, Md., is to have a new electric light plant.

An electric light company has been incorporated at Mt. Vernon, Ill., with a capital of $20,000.

The common council of Lynchburg, Va., has reported that a municipal electric light plant can be built at a cost of $62,000.

Proposals to light the streets of the village of Flushing, N. Y., will be received by the board of trustees until 8 P. M. on the 6th of June.

D. T. Mathers, city clerk of Woodbury, N. J., writes that the city has contracted with the Woodbury Electric Light and Power Co., for electric arc lights at a cost of eighty-five dollars per light per year, to burn on moonlight schedule.

W. W. Duel, clerk of Frankfort, N. Y., writes that the contract for lighting streets for one year, with eighteen arc lamps for the sum of $1,638.75 was let to the Frankfort Electric Light Company.

The streets of Rome, Italy, are shortly to be lighted throughout by electric lamps supplied by current from dynamos located at the cascade at Tibur, twenty miles from the city, in the Alban Hills. This plant is known as the Tivoli long distance power transmission line, and has been used considerably for experimental purposes before beginning practical work.

PUBLIC PARKS.

Ontario is to have a great National park and forest reservation in Nipissing district.

The town council of Highlands, Colo., have been petitioned for the purchase and maintenance of a public park.

The citizens of the North End, Newark, N. J., propose to purchase the property for the proposed Kearny park. It is valued at about $150,000.

Milwaukee, Wis., and Louisville, Ky., are putting in nurseries to raise the trees and plants required for their parks and boulevards. Milwaukee has expended about $5,000 and Louisville $3,600 for the purpose.

A number of business men in Leavenworth, Kansas, are deeply interested in a plan to convert a portion of the timbered lands on the government reservation into a National park for the preservation of buffaloes, elk, deer, antelope, prairie chickens, etc.

Mission Ridge Drive to Chickamauga National park will be finished this summer. The road, beginning at Sherman Heights and extending along the top of the ridge to the northern boundary of the park, will be fully six miles in length and from a scenic standpoint, one of the grandest in the country. The improvement of the park is steadily progressing.

STREET RAILWAYS.

An electric railroad is proposed between Oneida and Sylvan Beach, N. Y.

A project is on foot to establish a system of street railways in Cohoes, N. Y.

Hopkinton, Ashland and South Framington, Mass., are to be connected with electric cars.

Negotiations are begun for right-of-way for an electric line between Dallas and Ft. Worth, Tex.

The Morristown (Pa.) Passenger Railway Company will equip its lines with electricity, having voted $75,000 bonds for the purpose.

An electric railway between Egg Harbor City and May's Landing, N. J., is a possibility of the near future.

A hundred and thirty miles of street in Philadelphia will be torn up this summer for building trolley railroads.

The Citizens' Company, at Indianapolis, has decided to equip all horse lines with electricity as soon as possible.

An electric road is talked of from Hannibal to Palmyra, Mo. Funds have been raised for preliminary survey.

The North Highlands Railroad Co., of Columbus, Ga., will make extensive additions to the street railway system.

The running of electric cars by means of wires laid underground midway between the tracks has been successfully accomplished at Hartford, Conn.

The Tallahassee (Fla.) Street Railway Company has been given the right by the city council to construct and operate the trolley system for electric cars.

Youngstown, Ohio, will be connected with Cleveland and Pittsburgh by an electric railway, which will be constructed by a syndicate of eastern capitalists.

A. B. Phillips, city clerk of Ashtabula, Ohio, writes that the council recently granted a franchise to the East Side Street Railway Co. to build a street railway from the foot of Bridge street to Woodland Beach Park, a prominent summer resort recently purchased by the Lake Shore Railway officials. The storage battery system will be experimented with on this line.

The Indianapolis city council has granted a thirty-year franchise to the City Railway Company. The terms are the payment to the city out of the gross receipts for the first five years 10 per cent. per annum; for the second period of five years, 12½ per cent. per annum; for the third period of five years, 13½ per cent. per annum, and for the remaining fifteen years, 14½ per cent. per annum.

The intramural elevated railroad at the World's Fair has been practically tested on the finished portion of the line. This road is operated by electricity, the current being conveyed to the motors by a third rail, placed between the two wheel rails. Some new features are introduced in the construction of this road and the operation of the system is watched by electrical engineers with a good deal of interest.

MUNICIPAL BONDS.

J. A. Crawford, clerk of Benton Harbor, Mich., writes that that city will issue ten 6 per cent. bridge bonds, $500 each, for ten years, payable one each year, according to special act of legislature of April 27, 1893, Act 298.

SEALED PROPOSALS.

CONSTRUCTION OF BRIDGE.

Sealed proposals, addressed to the Auditor of St. Joseph county, South Bend, Ind., will be received by the Board of Commissioners of said county, until 12 o'clock noon Monday, June 5, 1893, for the furnishing of all material, the construction and erection of a through wrought iron bridge, to be completed by Nov. 10, 1893, consisting of a single span 150 feet in the clear, between abutments—no sidewalks—18 foot roadway, across the Bango creek, near Osceola, this county, the distance from grade to bed of stream is about 15 feet. The center line of bridge will be at right angles to face of abutments. The bridge must be of first class material, proportioned -Theodore Cooper's specifications being used—to carry 70 pounds per square foot of floor surface on trusses for live load, and 100 pounds live load per square foot on flooring system. Bidders to furnish a clearly made out strain sheet of their design, with data on which it was computed, and showing also areas of material proposed to be given to each part, together with forms of cross section of upper chords and posts, and compression members generally.

At the same time and place, separate bids will be received until the hour above named, for the furnishing of all material, and the construction of two stone abutments for said bridge, plans and specifications of which may be seen on file in said auditor's office. The masonry to be completed by September 15th, 1893. The commissioners reserve the right to reject any or all bids for either or both abutments and superstructure.

ROBERT MYLER,
Auditor of St. Joseph County.

WATER-WORKS.

Sealed proposals for the construction of a system of water-works will be received by the common council of Lake City, Minn., until 2 o'clock P. M., June 13. The work to be let comprises as follows: The furnishing f. o. b. cars or levee approximately of 13,896 feet of 4, 6, 8 and 10-inch cast iron water pipe, with necessary special castings; furnishing thirty-seven fire hydrants and thirteen valves with iron valve boxes; the laying of the above pipe and setting of valves and hydrants; one water tower, consisting of a 20x30 feet wooden tank upon a wooden tower 84 feet high, including all connections, foundation, etc., complete; brick pumping station 32 feet 4 inches by 55 feet with iron smoke-stack base; pumping plant comprising one 1,000,000 gallons duplex pumping engine and one 54 inches by 14 feet steel boiler, together with all appurtenances, connections and fittings set up complete—make of pump and boiler to be stated in bid; one brick well 16 feet in diameter and 20 feet deep. Bids will be received for the entire work complete, or separate bids for any one or more of the seven portions as above divided, and the right is reserved to accept such single bid or combination of bids as may be for the best interests of the city. A certified check, payable unconditionally to the order of the city treasurer, must accompany each bid, such check to be in amount equal to $100 for each portion bid upon or $500 for a bid covering the whole work. Plans and specifications are on file and can be seen and blank proposals obtained at the office of H. F. Jones, recorder; also at the office of the consulting engineer, C. F. Loweth, 94 East Fourth street, St. Paul, Minn.

H. A. YOUNG, Mayor,

PUMPING PLANT.

Sealed bids for the pumping plant for the pumping station at Charlestown will be received by the board of Metropolitan Sewerage Commissioners at its office, 110 Boylston street, Boston, Mass., until 12 o'clock M., July 1, and at that time will be publicly opened and read. The board will provide an engine-house, boiler-house, chimney and masonry foundations for the pumps, and will furnish a fresh water supply for the boilers up to the interior of the boiler-house. The contractor's bid must be for furnishing, setting up and completing, ready for use, two pumping engines (or sets of engines), two boilers, piping and all necessary appliances and fittings such as are to be found in pumping stations of the best class. Each pumping engine must be capable of easily raising 35 cubic feet of sewage per second, eleven feet vertically above the level of the sewage in its respective pump well. Each of the engines must also be capable of raising to greater lifts up to 30 feet, quantities of sewage inversely proportional to such lifts. The contractors must provide at each station two steam boilers of such capacity that either of them can easily supply the necessary steam for the two engines when discharging together 70 cubic feet per second, with a lift of 11 feet. The design of the pumping engines may be of any form which will fulfill the conditions named in the general specifications. Each bid must be made on one of the blank forms furnished by the board, and must be accompanied by a properly certified check for the sum of $1,000. Plans, blank forms, general specifications and further information may be obtained from

HOSEA KINGMAN.

NOTICE TO CONTRACTORS.

Sealed proposals will be received at the County Auditor's office, Columbus, Franklin county, Ohio, until 12 o'clock, noon, Monday, June 12, 1893, for the construction of the culverts and bridges on that part of the Pleasant Corners and Stringtown free pike, from the Concord meeting house, in Jackson township, north to the Stringtown free pike.

Bids will be received on the following:

(1) 2x2 box culvert-14 perch limestone masonry.

(2) Bridge—64 perch limestone masonry; also 15 lineal feet superstructure timber.

(3) 2x2 box culvert—14 perch limestone masonry.

(4) Bridge—60 perch limestone masonry; also 17 lineal feet superstructure timber.

(5) Bridge—52 perch limestone masonry; also 15 lineal feet superstructure timber.

(6) Bridge—60 perch limestone masonry; also 13 lineal feet superstructure timber.

(7) 2x2 box culvert—14 perch limestone masonry.

The County Commissioners reserve the right to reject any or all bids.

A certified check for $500 or good and sufficient bond for the same amount is required.

By order of the County Commissioners.

HENRY J. CAREN, County Auditor.

NOTICE TO CONTRACTORS.

Sealed proposals will be received at the office of the Board of County Commissioners, old court-house, Cleveland, O., until 12 o'clock noon, June 12, 1893, for grading, draining and improving by macadamizing or paving with brick or slag the following described county roads, to wit:

The Columbus or Wooster turnpike, in Parma, Middleburg and Strongsville townships.

A part of the Cleveland and Bedford road in Newburg and Bedford townships.

And a part of St. Clair road in Euclid and East Cleveland townships, according to a resolution of said board dated February 4, 1893.

Each bid must be accompanied by a sample of material bid upon with properly signed report of test of same as to durability and wearing qualities. Bidders are hereby notified to bid only upon specifications attached to the profiles in the office of Jay F. Brown, county engineer.

Plans and specifications may be seen and blank proposals can be obtained at the office of said engineer from the date of this notice.

Each proposal must contain the full name of the party or parties making the same and all persons interested therein, and must be accompanied by a bond of $500 signed by some disinterested person or persons resident of Cuyahoga county, or a certified check on a solvent bank in the city of Cleveland as a surety that if the proposal be accepted a contract will be entered into.

No proposals will be entertained unless made on blanks furnished by Jay F. Brown, county engineer, or the board of commissioners, and delivered at the office of said board previous to 12 o'clock noon on the day specified.

The county reserves the right to reject any or all bids.

By order of the Board of County Commissioners of Cuyahoga county.

Cleveland, O., May 13, 1893.

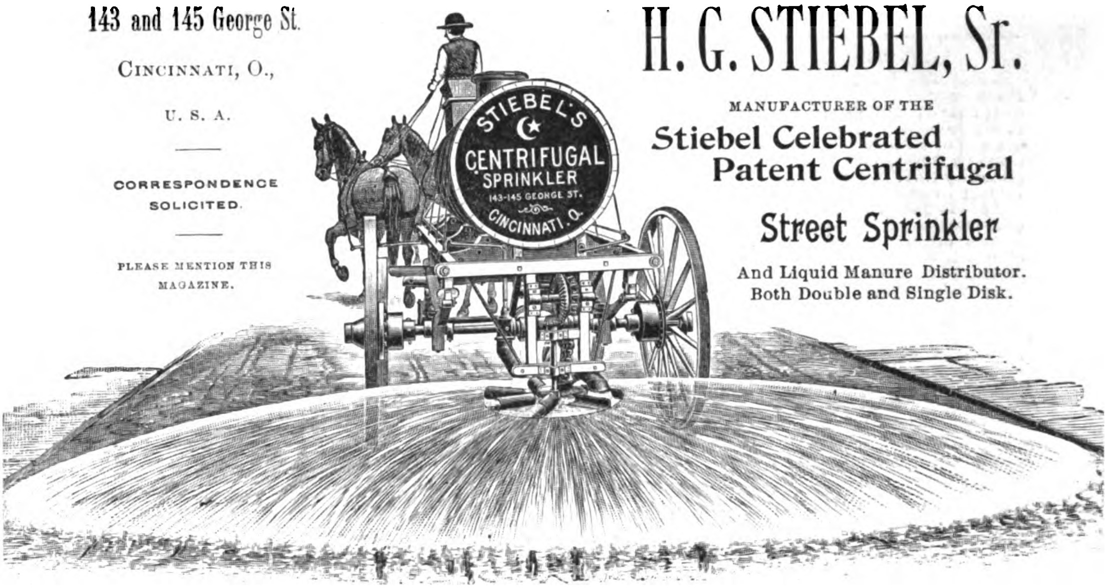
143 and 145 George St.
Cincinnati, O.,
U. S. A.

CORRESPONDENCE
SOLICITED.

PLEASE MENTION THIS
MAGAZINE.

H. G. STIEBEL, Sr.

MANUFACTURER OF THE
**Stiebel Celebrated
Patent Centrifugal
Street Sprinkler**
And Liquid Manure Distributor.
Both Double and Single Disk.



• STIEBEL'S •

CENTRIFUGAL PATENT SPRINKLER

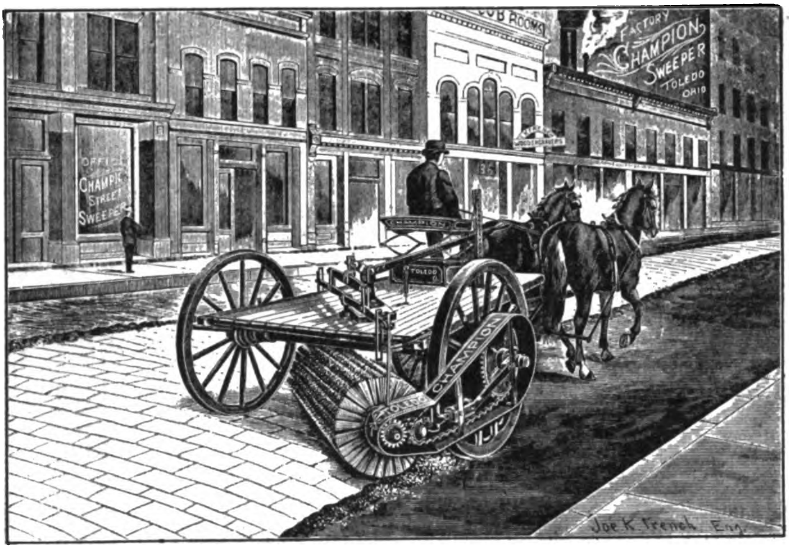
BOTH DOUBLE AND SINGLE DISCS.

❧ ❧

ECONOMY! SIMPLICITY! UTILITY!

In calling the attention of the public to Stiebel's Patent Centrifugal Sprinkler, we wish to emphasize the advantages which it presents as appreciable by skilled as well as unskilled men. As may be seen from the cut, the well known centrifugal power is utilized for distributing the water over the streets uniformly, economically and with the least possible labor. The gearing is of the simplest and most effective construction, strongly built and easily repaired by any blacksmith. By former methods the water carts had to pass up and down the streets three or four times, while in the device presented the attachments may be made to throw the water from 35 to 55 feet—*i. e.*, from curb to curb. In this way the number of carts, horses and wagons needed is reduced 50 per cent. or more, as exemplified in various cities where the Centrifugal Patent Sprinklers have been adopted, and where in one place the number of wagons has been reduced from 41 to 19. The importance of such reduction of constant labor will be recognized by all interested in reducing the expenditures of corporations in this line, and, as a natural consequence, can not but appeal to the minds of all who are working to reduce the taxes under which the people groan. Not only is labor saved, but by the new method there is no more filling up of the holes with water in the streets, and by the equal and uniform distribution more than one-third of the water is saved. In streets narrower than 30 feet one side can be made to do the work, either side or both being capable of complete control. The attachment is adjustable to the wagons now generally in use, so it is apparent that by a slight present outlay many thousands can be saved the public in future. Many testimonials in our possession from those who have had practical acquaintance with this device, and we ask, as we feel entitled to do, that it engage your earnest consideration, for we believe it to be one of the most economical, simple and useful of the machines which this age of inventions has produced.

H. G. STIEBEL, Sr.


FACTORY CHAMPION SWEEPER TOLEDO OHIO
OFFICE CHAMPION STREET SWEEPER
CHAMPION
TOLEDO
Joe K. French, Eng.

To the Hon. the Board of Public Works of the City of Saginaw:

GENTLEMEN—The question of purchasing street sweeping machinery for the eastern highway department, which was brought to your attention some time ago and referred to us to examine and report to you, has been under consideration by us for some time, and we now submit the following for your consideration:

We have examined the cuts and recommendations of six different machines and the testimonials of each from the city officers and municipal authorities of the cities where they are in use, and such other information as could be procured by correspondents, and we are of the opinion that the "Champion" is the best machine, everything considered, for our use.

The merits of the machine briefly are these: It will sweep from two to four inches of mud and street accumulations into windrows with one team of horses at one sweeping. It will sweep equally well on all kinds of pavements in all conditions. The use of steel wire in place of rattan or bass in the broom enables it to sweep equally clean in mud or dust and at a saving of nine tenths of the cost of keeping the brooms in repair.

Yours respectfully,
R. W. ROBERTS, City Engineer.
ALLISON J. MCINTYRE, Sup. of Streets.

At the meeting of the Board of Public Works, held March 18, 1893, the City Engineer was instructed to order "Champion" sweeping machine according to the recommendations hereto annexed.

Very respectfully, ALFRED DAVIS,
Clerk of the Board.

WHAT THE

"Champion" Sweepers Will Do.

Some Facts Worth Knowing.

They will move from 2 to 4 inches of wet mud and street accumulations into windrows, with one team of horses to each machine.

They will clean street car tracks of snow, 3 to 6 inches deep.

They will leave the streets cleaner than the most careful work done by hand, shovels and brooms, at one-tenth the cost of the latter.

They will sweep equally well on asphalt, cedar block, Medina stone, cobble-stone, macadam and brick paving.

One steel Broom will outwear from 10 to 20 of the rattan brooms now in use in other machines.

One Steel Broom, in constant use, will wear from 10 to 14 weeks.

Twenty dollars' worth of steel fibre will wear as long as two hundred dollars worth of the rattan used in other machines.

They will save their cost, broom and all, in half the first year's use.

They will give better satisfaction than any other sweeping machine that is manufactured in the world.

IN USE AT

St. Louis, Kansas City, Omaha, Denver, Cleveland, Detroit, Toronto, London, Dayton, Toledo, Mt. Clemens, Mich., Jackson, Mich.

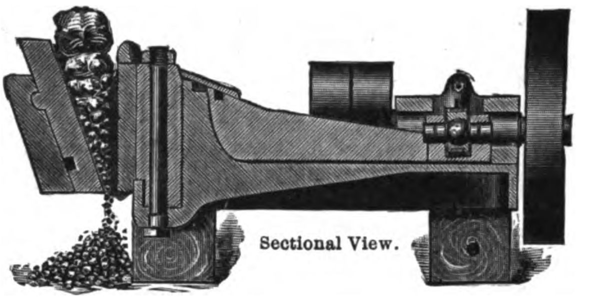
ONLY FACTORY IN THE WORLD DEVOTED EXCLUSIVELY TO THE MANUFACTURE OF STREET SWEEPING MACHINERY.

Address CHAMPION STREET SWEEPER

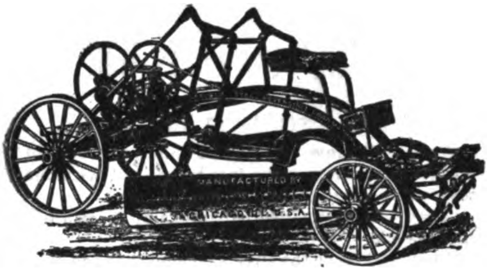
H. W. KNIGHT, Manufacturer. **TOLEDO, OHIO.**

F. C. AUSTIN MANFG. CO.

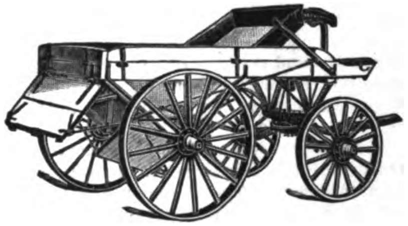
CHICAGO, ILLINOIS.



Chicago Rock Crusher.—For making macadam for country roads. Especially adapted for township use. Made in five sizes—15 to 200 tons per day capacity. Mounted on trucks when desired. Any ordinary laborer can manage it. It breaks rock into more uniform size and with less dust than other crushers.



Austin Steel Reversible Road Machine.—For building and repairing country roads, working streets in cities. Seventy-five per cent. saving in cost compared with plows and scrapers.

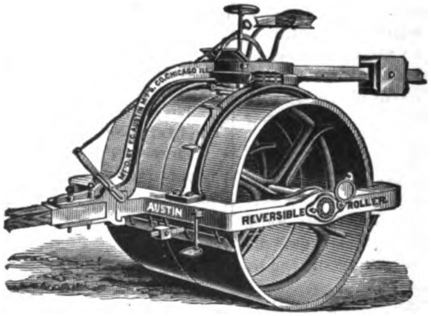


Austin Dump Wagon.—Built low and short and without reach, is easily loaded and quickly dumped, can be turned in its own length. A great saver of time over common dump boards.

SEE CIRCULAR

OF

STREET SWEEPER



AND AUSTIN

HAND GARBAGE

CART.

Austin Reversible Roller.—Made in three sizes—5-ton, 6-ton and 7-ton. Remarkable for their lightness of draft in proportion to their weight, owing to their large diameter and accurately fitted and adjusted hard steel anti-friction Roller Bearings.

FOR FULL PARTICULARS ADDRESS THE EXCLUSIVE MANUFACTURER.

F. C. AUSTIN MFG. CO., CHICAGO, ILL.

DYCKERHOFF PORTLAND CEMENT

IS THE BEST PORTLAND CEMENT MADE.

The Dyckerhoff Works produce not only the strongest, but also the safest and most reliable Portland Cement, unalterable in volume, not liable to crack and of a uniform, never varying quality.

While the price of the Dyckerhoff, owing to its more careful and expensive manufacture, is a trifle higher than that of most brands, its vastly greater strength permits a very much larger addition of sand which really makes it the cheapest and most reliable Cement in the market.

Pamphlet containing directions for testing and for the employment of Portland Cement together with testimonials will be mailed free on application.

E. Thiele, 78 William Street, New York,

Sole Agent United States.

IMPORTER OF LENNE VORWOHLE ASPHALT MASTIC.

Paving Pitch

FOR

Street Pavements

CORRESPONDENCE SOLICITED.

FOREST CITY CHEMICAL CO.,

339 WEST FRONT ST. CINCINNATI, OHIO.

WRITE FOR QUOTATIONS FOR . . . .

COAL TAR

DISTILLED COAL TAR

COAL TAR PAVING PITCH

TO . . . (STRAIGHT RUN)

THE WESTERN CHEMICAL CO., Coal Tar Products,

INDIANAPOLIS, IND.

P. O. Box 8. TELEPHONE 1447.

PORTLAND CEMENT

Between March 15th and May 1st the COLUMBUS PORTLAND CEMENT COMPANY will furnish prices on the highest quality of Portland Cement for this season's delivery.

Address correspondence to

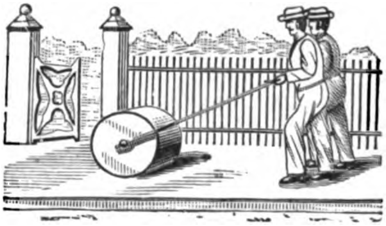
A. J. MURPHY, Secretary and Treasurer,

COLUMBUS PORTLAND CEMENT COMPANY. *COLUMBUS, OHIO.*

RHODE ISLAND CONCRETE CO.

ESTABLISHED 1865.

WM. H. SHATTUCK,
SUPERINTENDENT.

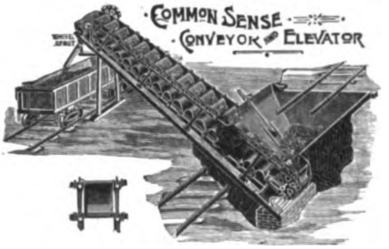


ESTABLISHED 1865.

JNO. S. WHITEHOUSE
AGENT.

We are large users of Trinidad Asphalt, and, while recognizing its superiority, we still believe that the coal tar products, properly manipulated, afford in many cases a valuable and comparatively inexpensive substitute, as our work in Rhode Island, Massachusetts, Connecticut and Brooklyn bears witness.

OFFICE, 9 CUSTOM HOUSE STREET, PROVIDENCE, R. I.



CLEVELAND, OHIO, November 20, 1892.

MR. C. O. BARTLETT, Cleveland, Ohio:

Dear Sir—We take pleasure in stating that we are using your COMMON SENSE CONVEYOR in handling Bituminous Lump Coal, and find that same works to our entire satisfaction. We heartily recommend it to any one desiring a conveyor for any purpose whatever. We are conveying two tons a minute.

Yours truly, THE AM. WATER TRANSPORTATION CO.
F. H. Briggs, Gen'l Manager.

South Bend Cement Co.,

SOUTH BEND, IND.

MANUFACTURERS OF

PORTLAND CEMENT

FINE, STRONG AND UNIFORMLY RELIABLE.

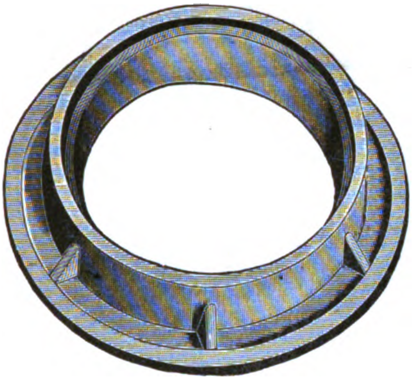
A. B. SHIVELY, SECRETARY.

HIGH GRADE WORK AND LOW PRICES.

CUTS MADE OF
BUILDINGS,
MACHINERY
AND CARDS.

WOOD
ENGRAVING
AND ALL KINDS OF
PROCESS WORK.

ESTIMATES CHEERFULLY FURNISHED.



EWALD OVER

INDIANAPOLIS, INDIANA.

Sewer Rings and Covers (Indianapolis Pattern)
All Steel and Iron Street Plows.
Road and Surface Ditching Machinery.
Wheel and Dump Scrapers.
Stone Crushers. Street Rollers.
Fire Cistern Rings and Covers.
Castings and Bolts for Bridges and Castings in General.

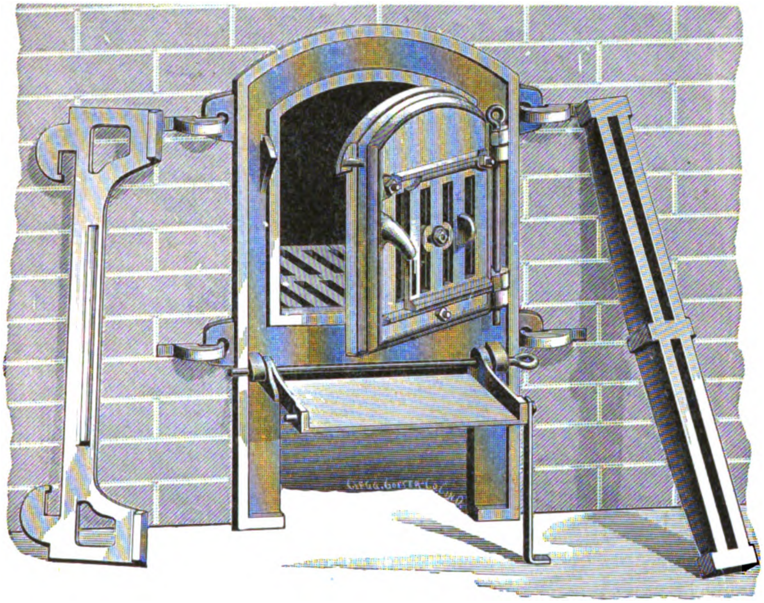
PRICES ON SEWER RINGS GREATLY REDUCED

SEND FOR CIRCULARS AND PRICES.

TO BRICKMAKERS

MARTIN'S PATENT REMOVABLE BRICK-KILN FURNACE.

FIVE HUNDRED SETS OF THESE FURNACES IN USE, AND GIVE PERFECT SATISFACTION.



WOOD, COAL, COKE OR TANBARK CAN BE BURNED IN THIS FURNACE. COST OF FUEL PER THOUSAND DOES NOT EXCEED SIXTY CENTS.

WRITE FOR PRICES

THE GERMANIA SUPPLY COMPANY, NINTH AND WASHINGTON STREETS, COVINGTON, KY.

FUEL GAS....

ADAPTED TO EVERY KIND OF KILN, FROM THE AMATEUR CHINA DECORATORS' KILN TO THE MAMMOTH BRICK KILN, AND TO EVERY KIND OF METALLURGICAL FURNACE. UNLIMITED TEMPERATURE WITH MINIMUM OF FUEL. SEND 2-CENT STAMP FOR PAMPHLET: PRODUCER vs. NATURAL GAS.

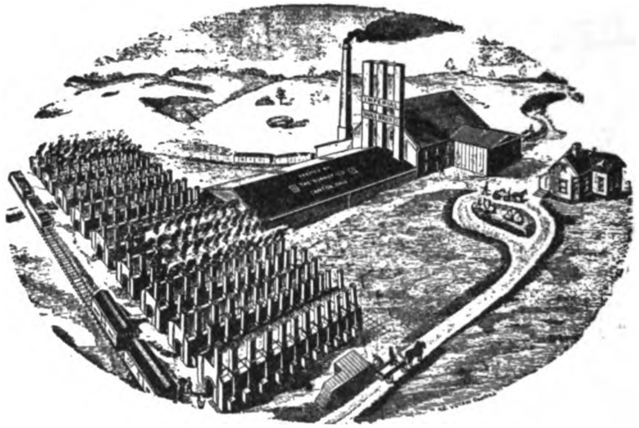
W. Waplington, 5428 Westminster Ave., Philadelphia, Pa.

Imperial Shale Brick Co.

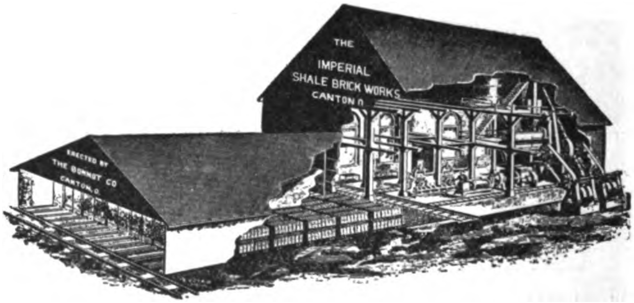
CANTON, OHIO,

EQUIPPED ENTIRELY BY

THE BONNOT CO., CANTON, OHIO.



This plant is known far and wide as the best equipped plant in the country. It will pay to visit it.


THE IMPERIAL SHALE BRICK WORKS CANTON O
ERECTED BY THE BONNOT CO CANTON O

INTERIOR VIEW OF IMPERIAL PLANT.

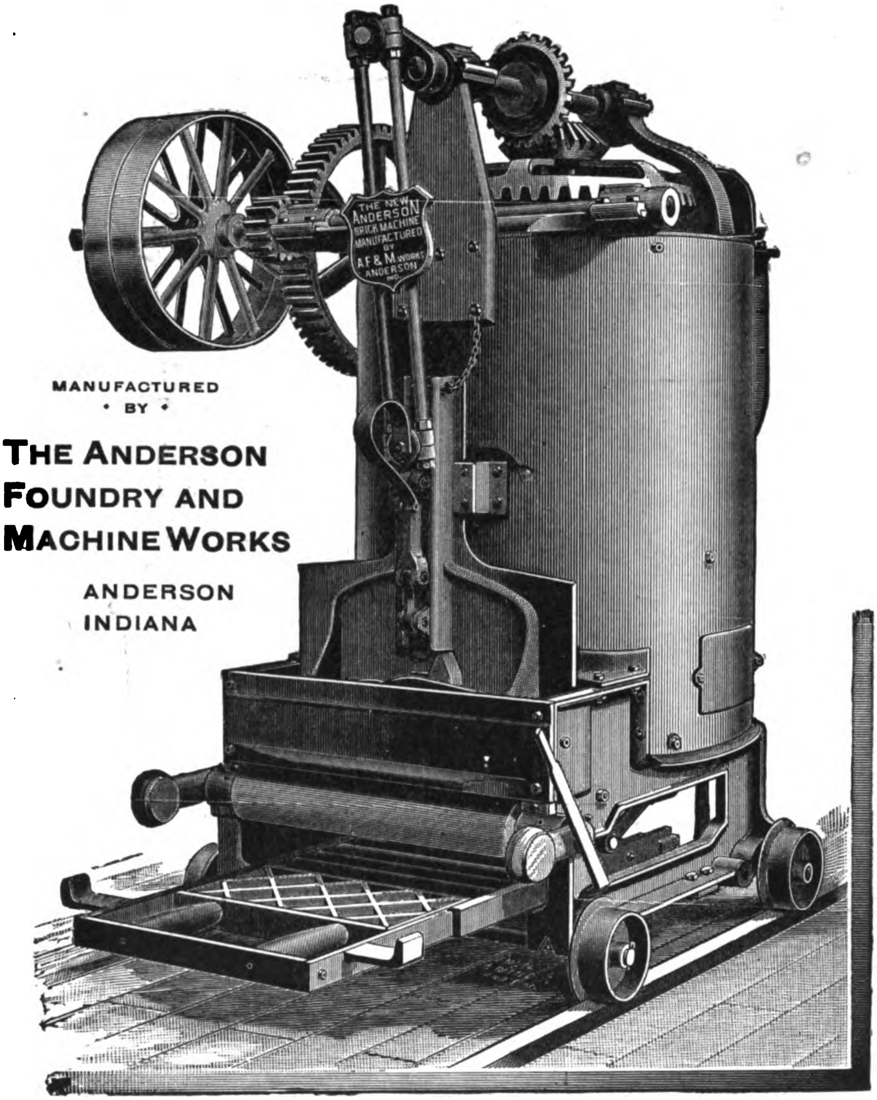
THE BONNOT CO. makes its own Cars, Dry Pans, Pug Mills, Screens, Shaftings, Pulleys, etc., and is prepared to furnish detailed estimates.

ENTIRE MACHINERY AND DRYER EQUIPMENT.

The attention of Brick-Makers is called to the Imperial Dryer. Results obtained have been unequaled. During the last year many complete plants were erected at various points. Capacity from twenty to seventy-five thousand. Write us for further information. Will be glad to furnish estimates.

The Bonnot Company, Canton, Ohio.

The New Anderson-Brick Machine



MANUFACTURED
• BY •

**THE ANDERSON
FOUNDRY AND
MACHINE WORKS**

ANDERSON
INDIANA

Anderson Foundry and Machine Works: DUBUQUE, IOWA, October 29, 1892.

GENTLEMEN—I have worked with the New Anderson Brick Machine, and I have turned out 3,000,000 of good square edged brick. Before I had this machine I was troubled right along. I have tried nearly all the machines now in operation, and none were a success until I got a New Anderson. Now I can depend on 30,000 good brick per day, and if any of you brother brick-makers want a machine, I would recommend the New Anderson Machine. Yours truly, A. HEIM, Proprietor.
JOHN HEIM, General Manager.

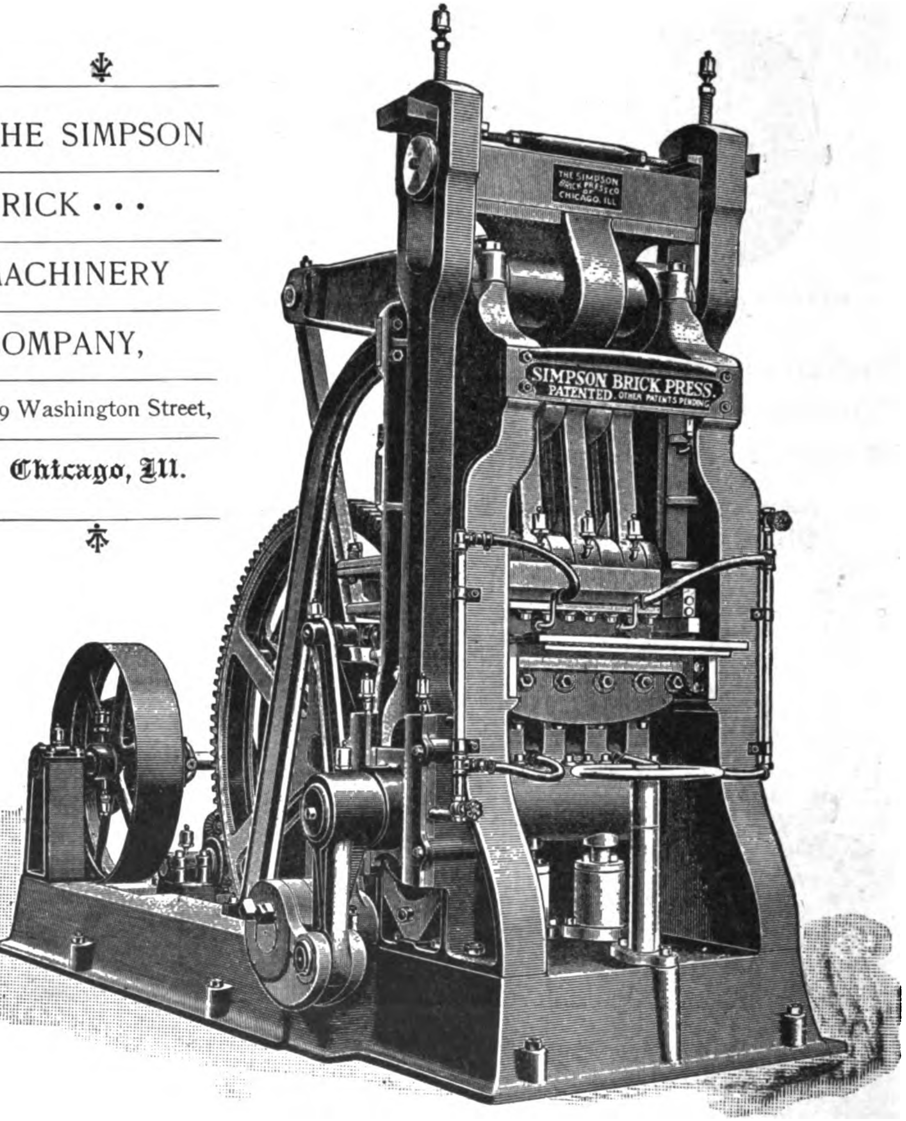
THE NEW ANDERSON is the perfection of mechanism for the production of first-class brick from any clay that can be worked by hand, or any similar process. It is unequaled for capacity and strength. Write for full description. We also manufacture the NEW DEPARTURE TILE AND BRICK MACHINE, PUG MILLS, CLAY ELEVATORS AND DISINTEGRATORS, and a complete line of Brickyard Supplies. CORRESPONDENCE SOLICITED.

(Mention this paper.)

THE "SIMPSON"

FOUR-MOLD PRESS

THE SIMPSON
BRICK • • •
MACHINERY
COMPANY,
89 Washington Street,
Chicago, Ill.


THE SIMPSON BRICK PRESS CO OF CHICAGO ILL
SIMPSON BRICK PRESS. PATENTED. OTHER PATENTS PENDING

POINTS OF SUPERIORITY OF SIMPSON BRICK PRESS.

1. **It has immense pressure.**
2. **It has immense strength.**
3. **It leaves no seam around the brick.**
4. **Thickness of bricks may be changed instantly.**
5. **All edges of bricks perfect.**
6. **It is sold under a guarantee.**
7. **Simple in construction.**
8. **Impossible to break with fair usage.**
9. **It is adjustable for wear.**
10. **Beautiful polish on bricks.**

WHY DOES

THE U. S. DRY CLAY

BRICK PRESS

MAKE BETTER PAVING BRICK THAN ANY OTHER MACHINE?

BECAUSE

IT IS STRONG, SIMPLE, DURABLE, CREATES GREAT PRESSURE, MAKES FINE FINISHED FACES, AND IS COVERED BY THE FOLLOWING PATENTS:

No. 315,855, April 14th, 1885.
No. 324,453, August 18th, 1885.
No. 375,660, December 27th, 1887
No. 395,871, January 8th, 1889.

WE BUILD { TWO MOLD / THREE MOLD / FOUR MOLD / SIX MOLD } MACHINES

Clay sent us, freight prepaid, will receive our prompt attention, pressed and burned, and sample brick returned.

✦

SEND FOR CATALOGUE AND PRICES TO

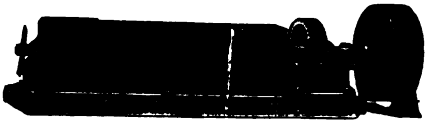
The United States Brick Press Company

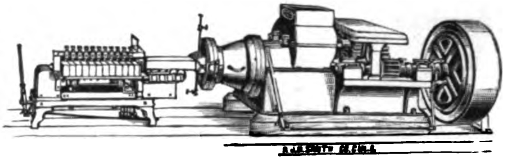
OSWALD KUTSCHE, Proprietor.

1111 UNITY BUILDING—79 DEARBORN STREET,
CHICAGO, ILL.

Mention this paper.

THE FATE-GUNSAULLUS COMPANY



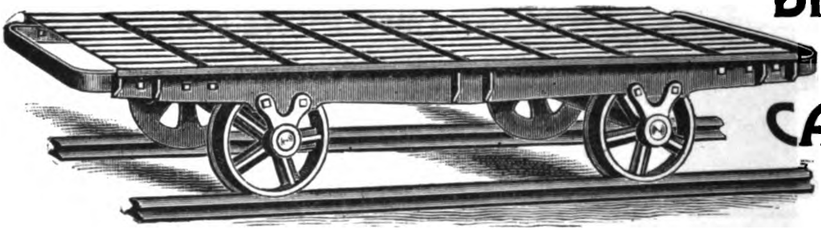


MANUFACTURERS OF . . . . .

Clay Working Machinery

PLYMOUTH, OHIO.

BUY THE BEST.



BRICK + CARS

48 STYLES

STYLE 18. FOR PAVING BRICK.

Be sure to have your Dryer equipped with our Cars. It will save you time, trouble and money. We manufacture a line of Cars for carrying all sorts of Brick and Tile. They are all iron, incomparably strong, easy running and low in price. It will be greatly to your advantage to trade with us.

SEND FOR CATALOGUE. **THE WALWORTH RUN FOUNDRY CO., CLEVELAND, OHIO.**

WE MANUFACTURE

BRICK AND TILE YARD SUPPLIES OF ALL KINDS

If needing anything in this line, please correspond.
Illustrated Catalogue Free.

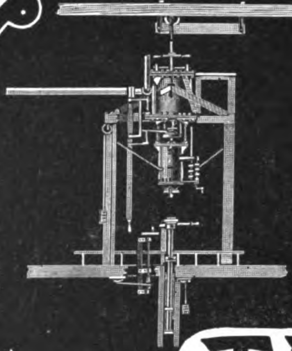
D. J. C. Arnold, New London, Ohio.

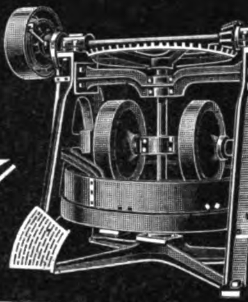
MANUFACTURERS OF
IMPROVED

CLAY WORKING MACHINERY

OF EVERY DESCRIPTION

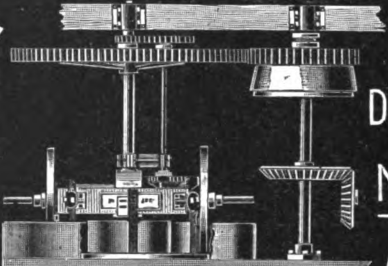
TAPLIN, RICE & CO.

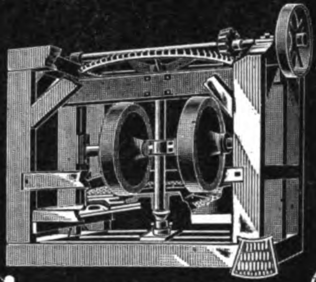




CLAY MILLS,
STEAM SEWER PIPE PRESS,
DRY & WET PANS, DIES, CLAY BLOCKERS,
POTTERS' WHEELS AND
MACHINERY OF ALL KINDS.

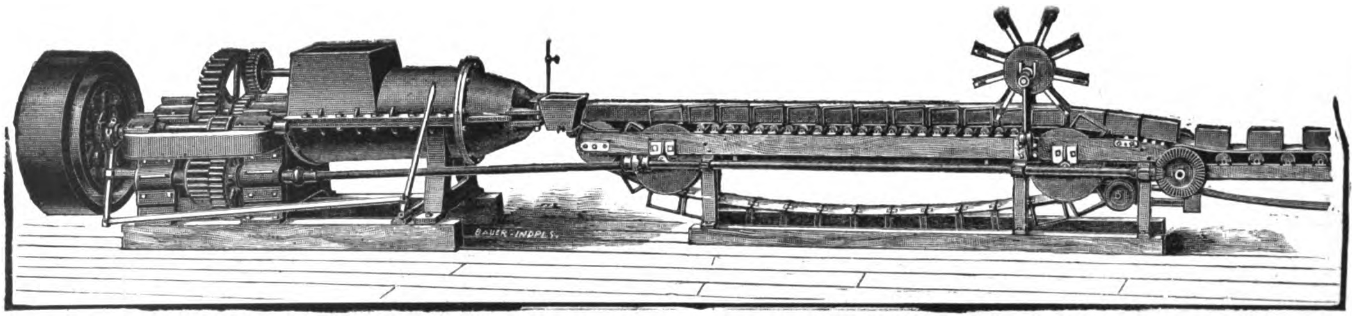
AKRON, OHIO, U.S.A.





PROMPT ATTENTION
& DISPATCH GIVEN
TO ORDERS

SEND FOR
CATALOGUE
A


BAUER-INDPLS.

DECATUR, WITH AUTOMATIC CUTTER.

WHEN LOOKING FOR A BRICK MACHINE

THAT IS NOT EXCELLED IN A SINGLE POINT OF EXCELLENCE, YOU CONSULT YOUR OWN INTERESTS WHEN YOU BUY OF US.

WE CAN ACCOMMODATE YOU FOR ANY CAPACITY, AND GIVE SATISFACTION. WRITE FOR PRINTED MATTER.

The Decatur Leader Manufacturing Co.,

DECATUR, ILLINOIS, U. S. A.

If readers of this advertisement who wish to purchase goods in our line would mention the paper when writing for information, or when ordering goods from us, we could then determine whether the money we pay for advertising in this paper is well invested or not.

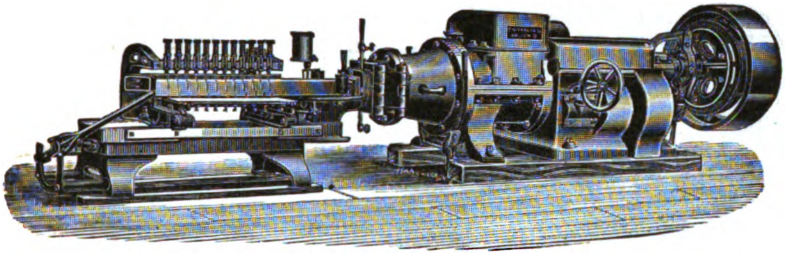
"OHIO"

BRICK MACHINERY

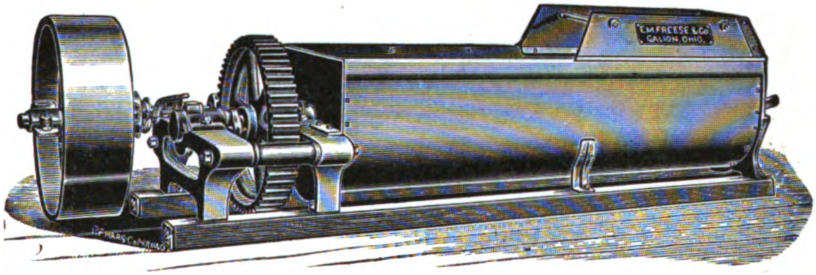
◄ ◄ ◄

Unequaled

- CAPACITY
- QUALITY OF PRODUCT
- STRENGTH
- DURABILITY



"MAMMOTH JUNIOR" BRICK MACHINE.



No. I PUG MILL.

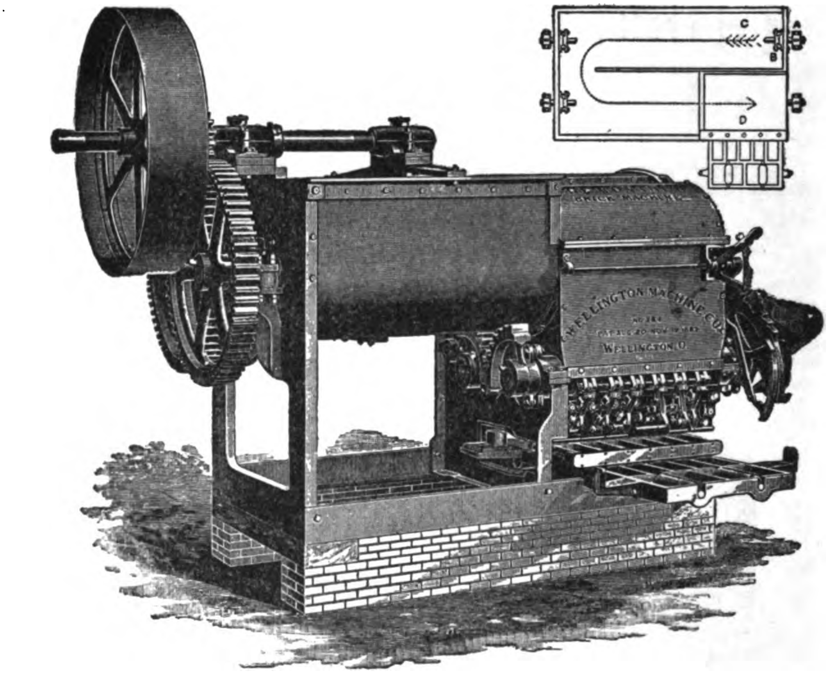
WHERE PAVING BRICK ARE MANUFACTURED
THERE IS THE "OHIO" THE FAVORITE MACHINE

Manufactured by **E. M. FREESE & CO.**
Galion, Ohio.

WRITE TO THEM FOR
ESTIMATES AND PARTICULARS.

THE "MONARCH"

BRICK MACHINE



A COMBINED pug-mill and brick machine of the "soft-mud" class. **Investigation** of its **entirely new** principles will carry conviction (comparing it with machines of its class) that

It has the greatest tempering capacity (14 feet of pug-mill).

It has the greatest pressing capacity (working stiffer mud than all others of its class)

Its "life" will be ten times that of any other.

It is the strongest, handiest, easiest running, most compact and simplest.

It will produce the largest quantity of the very best quality of brick.

It is very reasonable in price for what it is.

Send for circular, and ask for nearest place to see one in operation.

The Wellington Machine Company, Wellington, Ohio.

V. H. LOCKWOOD,

Patents

SOLICITOR AND COUNSEL,

(Successor to CHAS. P. JACOBS)

NO. 60 EAST MARKET STREET,

INDIANAPOLIS.

PATENTS

GEORGE E. LEMON,

Lemon Building, Washington, D. C.,

Counsellor at Law, Solicitor of American and Foreign Patents.

Opinions rendered as to the novelty and patentability of inventions and validity of patents. Rejected applications prosecuted. All business relating to patents promptly attended to.

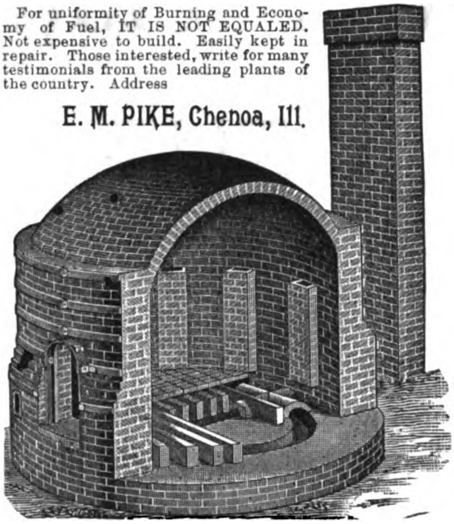
Established 1865. Send for 67-Page Pamphlet.

NEW DISCOVERY

DOWN DRAFT KILN

For uniformity of Burning and Economy of Fuel, IT IS NOT EQUALED. Not expensive to build. Easily kept in repair. Those interested, write for many testimonials from the leading plants of the country. Address

E. M. PIKE, Chenoa, Ill.



D. C. Winebrener, President.
Wilbur H. Duvall, Sec.-Treas.
John Baumgardner, Gen'l Manager.
OFFICE OF THE FREDERICK TILE WORKS.
FREDERICK, MD., June 30, 1892.

E. M. PIKE, Chenoa, Ill.:

Dear Sir—We are in receipt of yours of the 14th inst. We are using four of your New DISCOVERY Kilns, burning from 65,000 to 75,000 bricks at a burn; we have no imperfect bricks. Are running our works at full capacity, but find we will need more kilns, which we expect to build in the near future. Yours truly. WILBUR H. DUVALL, Sec'y.

Cleveland, Cincinnati, Chicago & St. Louis BIG 4

SOLID VESTIBULE TRAINS

Heated with Steam and Lighted by Gas.

CONSISTING OF

The Finest Coaches, Parlor, Reclining Chair Car, Cafe and Dining Cars; Wagner Compartment, Buffet and Standard SLEEPING CARS,

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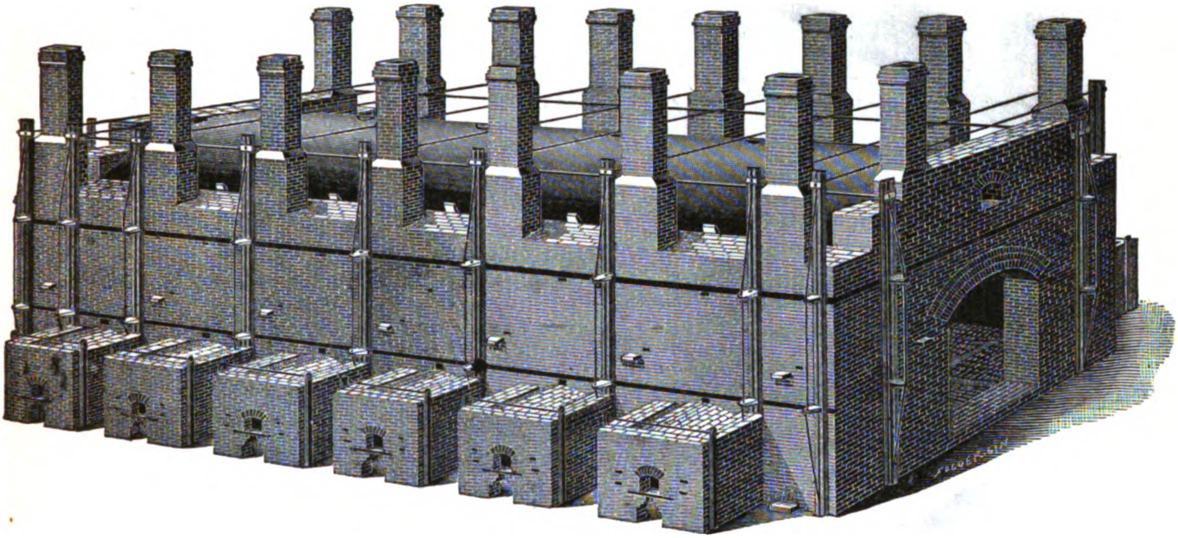

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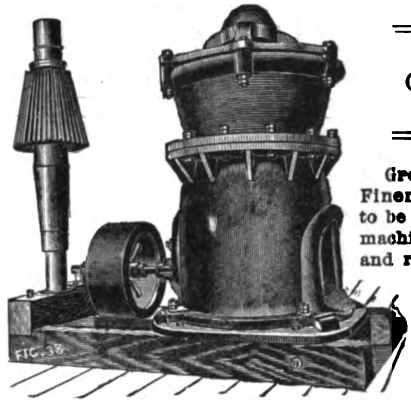

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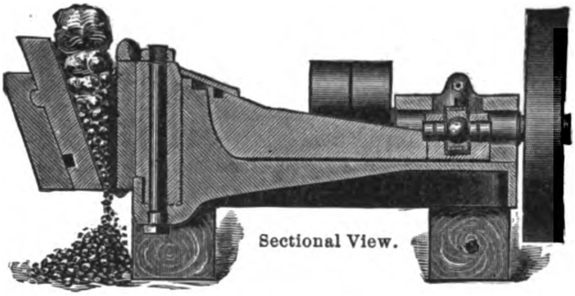
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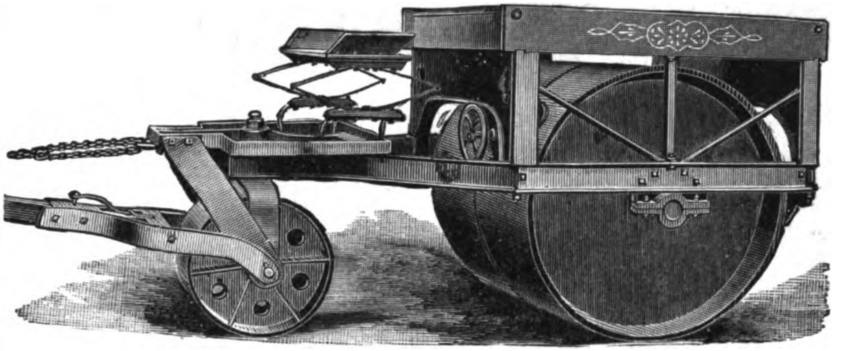

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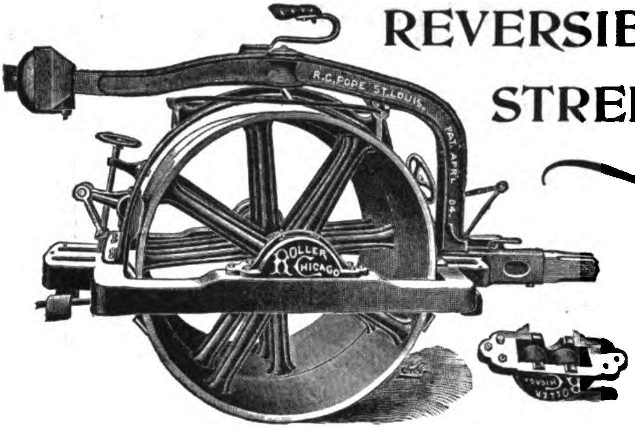

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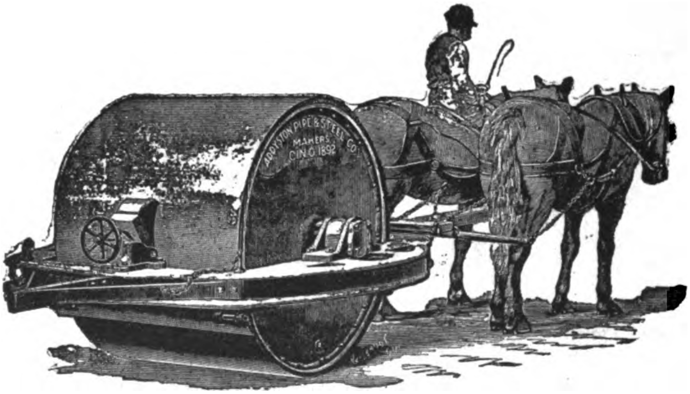

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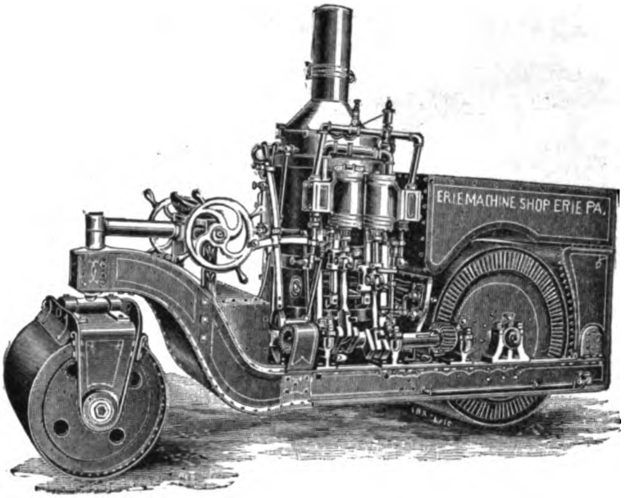
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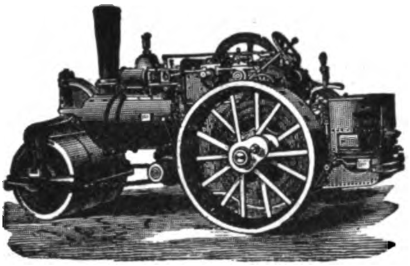

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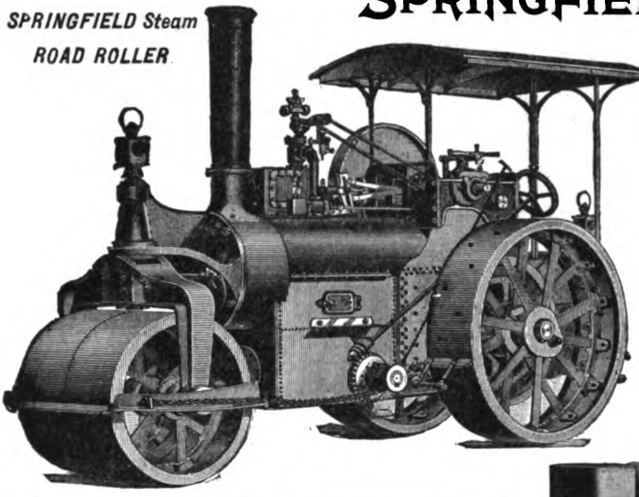

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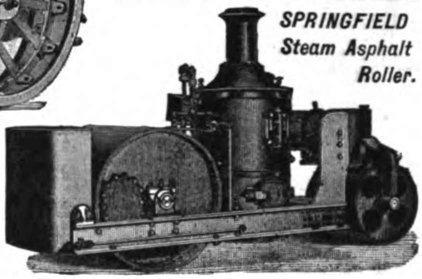

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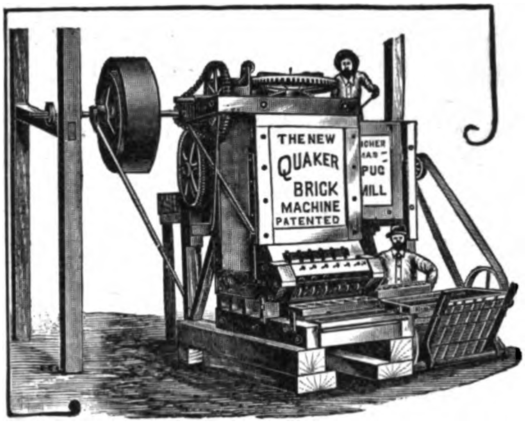

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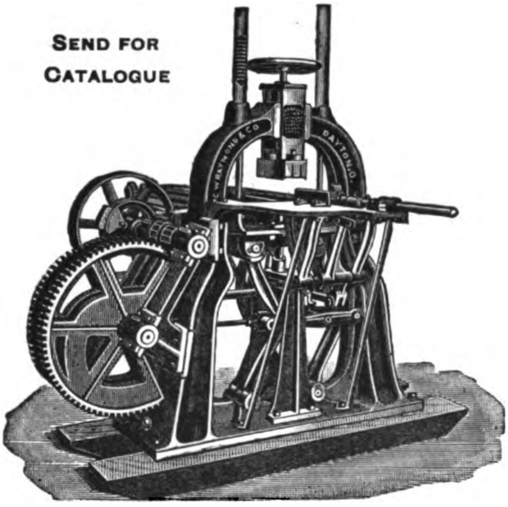
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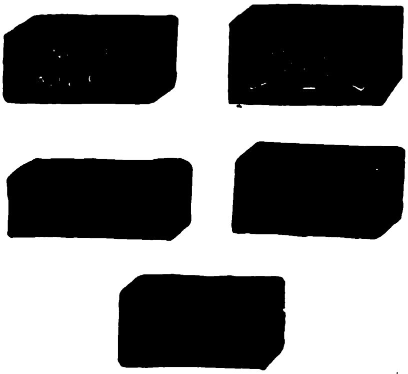

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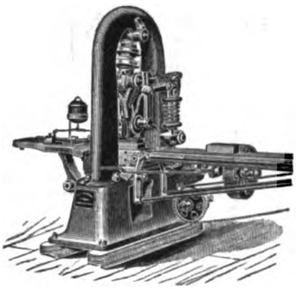

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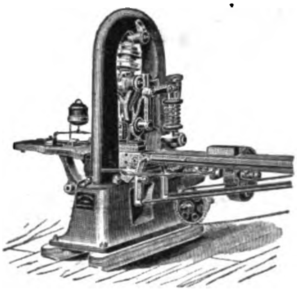

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